ELECTRICAL ENGINEERING

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AUGUST
1953

The Cover: A new instrument capable of detecting very minute quantities of any element is the ion-scattering analyzer recently constructed at the Stanford Research Institute, Stanford, Calif. This "proton bombarder" consists mainly of a 2,000,000-volt Van de Graaff generator supported 9 feet above the laboratory floor by a steel framework, a 20-foot vacuum tube, and two large electromagnets.

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HIGHLIGHTS.....

Incoming President. The election of Elgin B. Robertson of Dallas, Tex., as President of the Institute for 1953–54 was announced at the Annual Meeting of the AIEE on June 15. Mr. Robertson, who succeeds D. A. Quarles, is president of Elgin B. Robertson, Inc. Prior to his election to the Institute presidency, he had been a Director of the AIEE.

Summer General Meeting Held. A new attendance record for AIEE Summer General Meetings was set when the Institute convened in Atlantic City, N. J., in June. Featured at the meeting were 55 technical sessions in addition to the many opportunities for recreation afforded by the famed seaside resort (*pages 712–16*). Also during the meeting, an all-day Section Delegates' Conference was held which covered such topics as registration of engineers, the Student Branches, Section organization and management, and the work of the Board of Examiners (*pages 708–12*).

Coming Meetings. The next General meeting of the Institute will be held September 1–4, when the Pacific General Meeting takes place in Vancouver, British Columbia, Canada. The tentative technical program and a brief outline of the social activities planned are included in this issue (*pages 705–07*). Other meetings scheduled during the next few months include the Middle Eastern District Meeting in Charleston, W. Va., (*page 718*), the Aircraft Electric Equipment Conference in Seattle, Wash., (*page 718*), and the Fall General Meeting in Kansas City, Mo., in November (*page 717*).

Board of Directors' Report. The 69th annual report of the AIEE Board of Directors covering the fiscal year ending April 30, 1953, is included in full in this issue. It contains brief summaries of the activities of the Institute and its committees during the year, as well as of the activities participated in jointly with other organizations. It also presents the accountants' statements showing the financial condition of the Institute at the close of the fiscal year (*pages 721–56*).

Progress and Problems. In his final address as President of the Institute, Mr. Quarles evaluates some of the more important accomplishments during the past several years, and during his own administrative year in particular. He points out the problems brought about by the growth in technical activities, the decrease in Student membership, and the increasing need for professional unity. The address was presented during the recent Summer General Meeting in Atlantic City (*pages 667–9*).

The Spirit of Discovery: An Appreciation of the Work of Marconi. Major E. H. Armstrong brings to attention the real exploratory work that Marconi did, especially in the field of radio short waves and microwaves, and shows that this great Italian Nobel prize winner maintained an open mind in the gathering of experimental facts (*pages 670–6*).

Present Feasibility of a Nuclear Power Plant. Within the past year and a half it has been shown twice that it is possible to produce electric power utilizing the heat developed in a nuclear power plant. The design of a suitable nuclear reactor feasible from engineering and economic viewpoints is described (*pages 678–83*).

The Hissing Arc and Radio-Frequency Self-Generated Oscillations in the D-C Carbon Arc. This experimentation showed that an abrupt drop in voltage occurred when the carbon arc begins to hiss in air, nitrogen, oxygen, and hydrogen, but not in inert gases or gases such as carbon dioxide. It seems to be caused by a change of mechanism for supplying positive ions at the anode in the former group, while in the latter group no products are formed with lower ionization potentials than those already existing in the arc. In addition, with metallic electrodes there is no voltage drop as the ionization potential of the metal is lower than that of the product formed (*pages 683–6*).

Methods of Magnetic Amplifier Analysis. A preliminary orientation in the basic ways of thinking and their gradual development are presented. The many published analyses of magnetic amplifiers have been reduced to fewer basic groups differentiated by the kind of approach selected to overcome the difficulties of nonlinear problems which escape unified treatment. Progress continues and is reflected in the most recent publications in this field (*pages 690–4*).

Motor Overload Protection for Domestic Appliances. Underwriters' Laboratories, Inc., classifies those domestic appliances where a potential hazard is likely to exist. Such a hazard is considered as resulting from the starting condition of a motor or severe overload condition if existing for an appreciable time. Then tests are made to ensure that adequate safeguards against these hazards are provided in the motor or within the appliance itself (*pages 694–6*).

Axle-Driven Alternator-Rectifier System for Caboose Power Supply. As there long has been a need for a dependable power supply for railway cabooses, the new system described here should prove of great value. It offers in addition to reliability, simplicity, low initial and maintenance costs, light weight, small size, and tremendous speed range and versatility (*pages 699–703*).

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Bimonthly Publications

The bimonthly publications, *Communication and Electronics*, *Applications and Industry*, and *Power Apparatus and Systems*, contain the formally reviewed and approved numbered papers (exclusive of ACO's) presented at General and District meetings. The publications are on an annual subscription basis. In consideration of payment of dues, members (exclusive of Student members) may receive one of the three publications; additional publications are offered to members at an annual subscription price of $2.50 each. The publications also are available to Student members at the annual subscription rate of $2.50 each. Nonmembers may subscribe on an advance annual subscription basis of $5.00 each (plus 50 cents for foreign postage payable in advance in New York exchange). Single copies, when available, are $1.00 each. Discounts are allowed to libraries, publishers, and subscription agencies.

Membership in the American Institute of Electrical Engineers, including a subscription to this publication, is open to most electrical engineers. Complete information as to the membership grades, qualifications, and fees may be obtained from Mr. H. H. Henline, Secretary, 33 West 39th Street, New York 18, N. Y.

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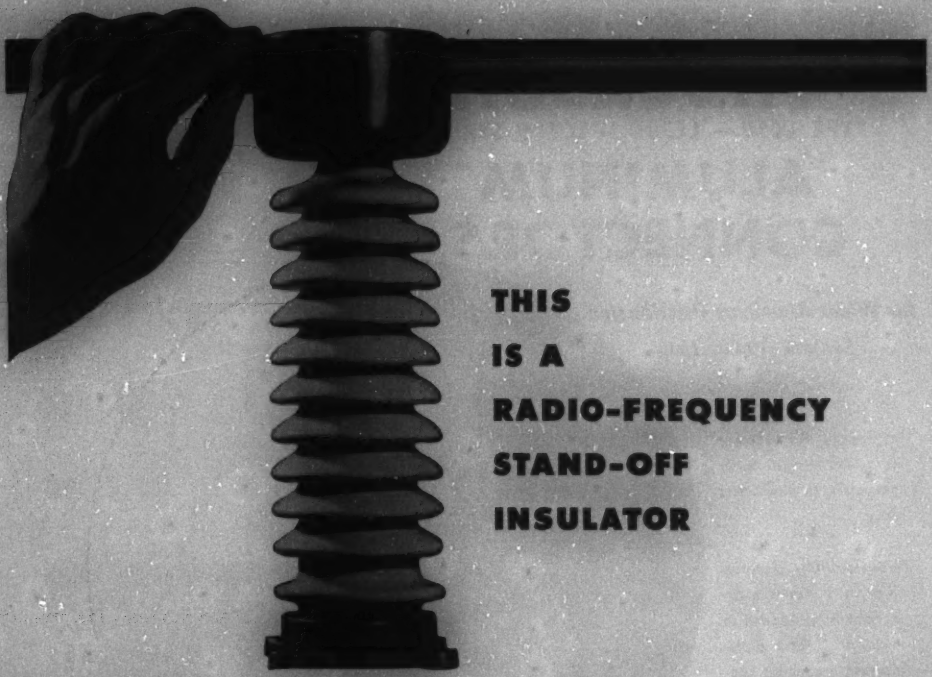

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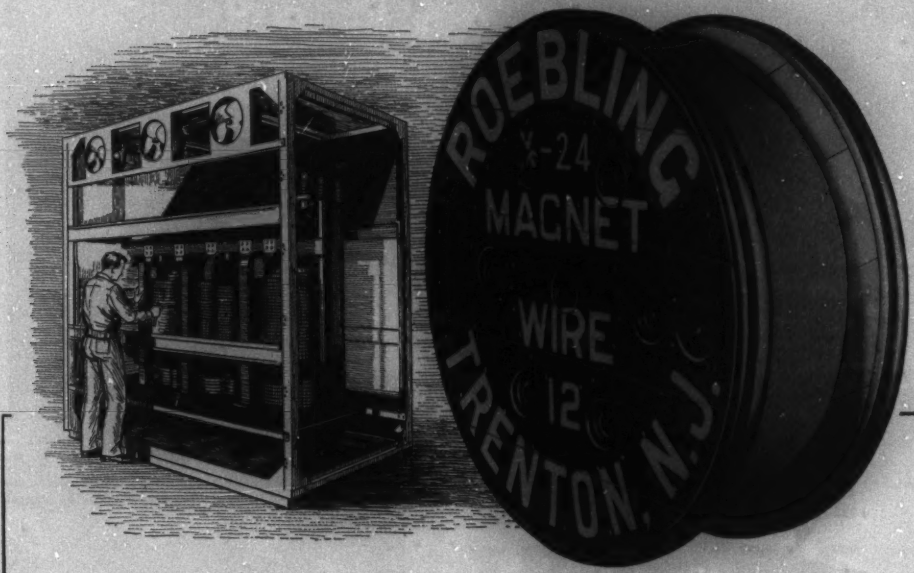

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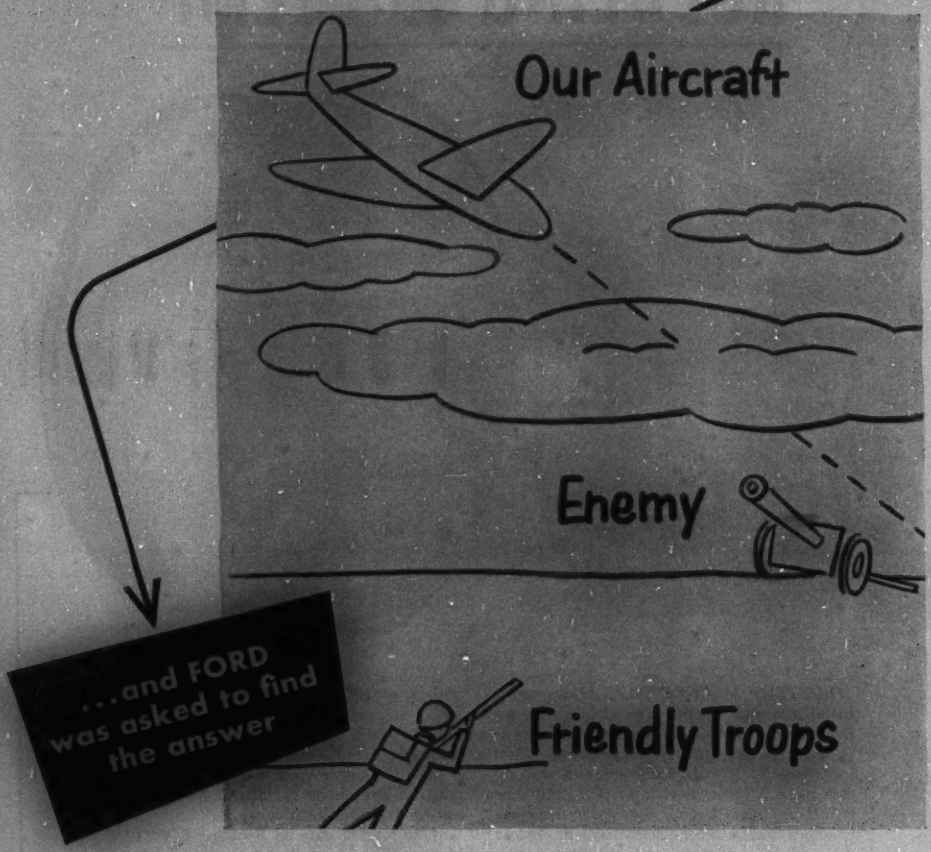

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Progress and Problems

D. A. QUARLES
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At the close of the 1952–53 administrative year, Mr. Quarles takes a look at the Institute's record during his term as president. During this time, the AIEE embarked upon a new organizational policy and also instituted a new publication plan for the technical papers.

THIS ANNUAL meeting anticipates the close in July of our 1952–53 administrative year. To borrow collegiate terminology, it is the time for final examinations to test our progress and accomplishments and for commencement sentiments emphasizing the problems and challenges of the future.

As I look at the work of the organization in the past year I am inclined to feel that it should be excused from final examinations and given "A" for accomplishment on its record.

Let us look at some of the highlights of this record over the past several years. In all areas it is impressive. In the 8 years since World War II the Institute has gained more members than in the whole prior 60 years of its history. It now stands well over 45,000 and in each of the past 5 years the membership applications have ranged from 4,000 to 6,500, depending largely on fluctuation in student enrollment in the engineering colleges. During this period about half of our new applications for membership have come from students. From a peak of about 80,000, electrical engineering student enrollment in the colleges dropped a couple of years ago to just over 20,000 with a moderate increase this last year to around 25,000. In spite of this recession in student enrollment we gained somewhat more than 4,000 new members in the fiscal year just ended, and present indications are that membership growth is likely to continue at about the present rate unless there is some important change in general conditions.

TECHNICAL ACTIVITIES

THE GROWTH in technical activities has been even more rapid. Attendance, technical papers, and technical sessions at our Winter General Meeting have multiplied by factors in excess of three in this period. Corresponding figures for the Summer General Meeting show a somewhat more moderate growth, but still in excess of a factor of two. While this growth in technical interest is very gratifying, it at the same time poses a problem—an embarrassment of riches—that I will want to discuss further later on.

On the local level there have been corresponding developments. Not only has the Section membership more than doubled in the past 10 years, but the number of Sections has increased some 50 per cent to almost 100; the activity of the Sections as measured by number of meetings has more than doubled; and the organization of joint engineering society councils or the equivalent on the local level has shown rapid progress.

Activities in Student Branches naturally have paralleled student enrollment. While, as mentioned earlier, total electrical engineering enrollment in the colleges has gone from 80,000 in 1947–48 down to 21,000 in 1951–52 and now back to 25,000 in 1952–53, AIEE Student enrollment has shown a somewhat disproportionate drop and this in spite of very active and competent work by the Student Branch Committee. In the 1949–51 period we had about 60 per cent of the electrical engineering students as AIEE Student members. Latest figures show only about 30 per cent of the students so enrolled. Paralleling this there has been rapid growth in the joint AIEE–Institute of Radio Engineers (IRE) Student Branches and it well may be that AIEE is not faring as well as it should in the competition with IRE for student interest. This is a situation that requires close watching. This area of Student Branches certainly rates as one of our future challenges.

Returning to technical operations, you will recall that this has been our first year under the new organization in which the technical affairs of the Institute are centered in the Technical Operations Committee under Chairman Hickernell. One year is too short a time to see the full effect of such a move but I know of no one who questions that the move was a sound one. The activities of the technical Divisions and committees are so closely related to the Institute's technical programs that it is very important that there be a central co-ordinating agency in the form of the Technical Operations Committee. Fortunately, too, it has been possible to appoint Chairman Hickernell as chairman of the Technical Operations Committee to fill a vacancy in the Board of Directors which gives very proper representation in the Board to this committee and assures that the Board is properly advised in relation to technical affairs.

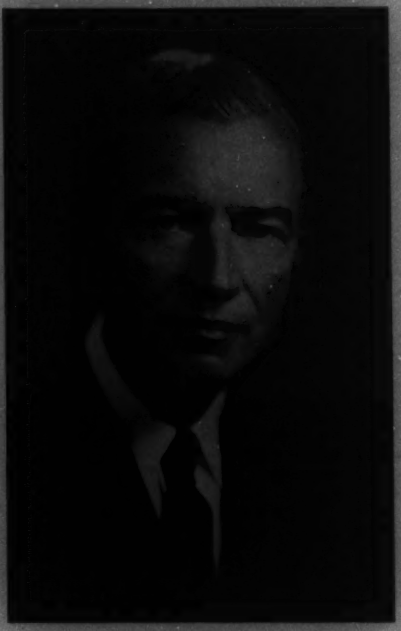
In technical operations there are a number of trends that need to be taken into account. The embarrassingly heavy offering of technical papers, particularly at the Winter General Meeting, already has been mentioned. There also has been a large increase in interest in Special Technical Conferences, of which we now are holding some 15 or 16 a year with average enrollments of around 400. There were, for example, some 1,500 at the Electronic Components Conference in Pasadena, Calif., in April, AIEE being one of the sponsors. On the other hand, it is my impression that in their present form our District meetings are losing ground as a technical medium,

Full text of an address presented at the AIEE Summer General Meeting, Atlantic City, N. J., June 15–19, 1953.

D. A. Quarles, AIEE past president (1952–53), is president of the Sandia Corporation and vice-president, Western Electric Company, Inc., Albuquerque, N. Mex.

even though they have been fairly well attended and even though there is still a clear and definite need for the opportunity afforded by the District meeting to transact District business and cultivate District interests, particularly those of their Sections and Student Branches. Our Technical Operations Committee is already aware of this situation and is seeking a solution. This might lie along the line of having the Districts sponsor specialized technical programs, replacing some of the Special Technical Conferences. In this case the technical Division or committee would assume responsibility for the technical program, with the District acting as host and retaining responsibility for strictly District functions.

A related matter has to do with publication of technical papers. Less than half of the papers presented at our General and District meetings and technical conferences are now *Transactions* papers and, therefore, available as publications. Some of the technical conferences publish and make available a transcript of their proceedings. In some other cases authors make copies of their papers available at their own expense. The Publication and Technical Operations Committees regard this as one of their unsolved problems—one of their challenges for the future. A possible solution that is being considered would be to microfilm papers that would not be published otherwise and furnish photoprints at cost to those wishing to purchase them. I believe that those desiring copies of the papers will be quite willing to pay the freight if a method can be worked out.



D. A. Quarles

As regards the 40 to 50 per cent of the technical papers that are accepted for the *Transactions*, our first year of operation under the new publication plan, which publishes these bimonthly in three technical divisions, and makes one of the three publications available to each member without charge, is working out so well that there is no longer any doubt as to the wisdom of this move. As noted, however, the Publication Committee in spite of this success still sees some challenges ahead, particularly in the handling of conference and other non-*Transactions* papers.

One topic that has been surprisingly quiet in the last year or so is that of membership dues. Our dues have remained unchanged for 25 years. The prospect 5 or 10 years ago was that inflation and the shrinking dollar would require the Institute to raise its schedule of dues. In fact, a constitutional change was voted at that time to empower the Board of Directors to change dues as circumstances might require. Not only has this not become necessary but, as long as present trends continue, there is no immediate prospect of it. This means that our dues dollars are as big or bigger than ever in spite of the fact that most other kinds of dollars have shrunk to about half size. I believe you will want me to give our finance managers a grade of "A" without further examination. They are achieving a balanced budget at just about twice the expense level of 10 years ago. However, they would not thank me if I gave the impression that increased budget allowances are available for the asking. It is a nip-and-tuck proposition each year whether increased revenues from advertising and the influx of new members can be made to offset rising costs and prices.

One thing of interest in this connection is the possibility of a new engineering headquarters building. United Engineering Trustees (UET) have a very active project underway looking toward a new home for not only the four Founder Societies, who were beneficiaries of the original Carnegie gift of some 50 years ago, but also for other similar societies who might elect to join in the undertaking. There is general agreement that present facilities are inadequate and that UET proposals offer a satisfactory, broad basis for a new building. There are many problems to be worked out, including the major ones of size, location, participating societies, and methods of financing, but none of these appears to be insurmountable. Perhaps of greatest importance is the confident determination of our representatives on UET to see the project through. If we are limited to presently available resources in financing the new building, borrowing the balance on mortgage, the increased rental charges to AIEE could be as much as 5 or 6 per cent of our total annual budget. While I do not regard this as prohibitive, it does emphasize the importance of a campaign for individual and corporate contributions as a substitute for mortgage borrowing. This is another challenge that we leave for the future.

PROFESSIONAL PROGRESS

On the broad professional front we can report progress. I am afraid, however, that this is small compared

with the problems ahead. During the past year the Engineers Joint Council (EJC) constitution has been liberalized and there are now eight as compared with the original five constituent societies. EJC has carried forward an effective Engineering Manpower Program; has formulated and presented effectively the engineering viewpoint in regard to Taft-Hartley Act revision, which incidentally now appears to have been shelved by this session of Congress; and in many other matters has made it possible for the engineering profession to present a united front. Engineers' Council for Professional Development (ECPD), embracing our sister society in Canada as well as the EJC societies, has continued its strong and effective programs, particularly in the field of accreditation of the curricula of engineering colleges. AIEE co-operates wholeheartedly in these joint professional organizations and we may take real pride in their accomplishments. In comparison with our goal of professional unity, however, these are only beginnings. The pursuit of professional unity is certainly one of the challenges that this administration is passing on to the next. One recent event, which I regard as a setback for this movement, was the decision of IRE to turn down the invitation that had been extended to it to join EJC. The IRE response cites two basic policies to which IRE has adhered and which it feels to be inconsistent with EJC membership: (1) not to engage directly or indirectly in legislative activity and (2) not to assume that IRE is entitled to represent its members in social and general professional matters. This, of course, is a decision that IRE is entitled to make and that we are not entitled to question. Even so, the last sentence of the IRE response is significant. I quote, "However, the Board of Directors looks favorably upon co-operative activity with the EJC on any specific problems of mutual interest in which the Institute can engage within the policy framework above stated." This suggests that the door is not closed to some other pattern of co-operation.

There are quite possibly other situations where some kind of co-operation with EJC short of full membership is indicated. For example, there are areas of collaboration with our sister societies in Canada such as the ECPD area previously mentioned. If these areas of common interests are not general enough to warrant full membership in an EJC structure, it ought to be possible to devise some form of limited or associate membership that would be appropriate. What is important I think is that we continue to press for an effective pattern of integrating these common interests; in short, for an effective professional unity. If we succeed, as I believe we must, this would not be the first time that a strong union has evolved out of a weak federation. This, however, will be no mean task.

You will note that I have singled out for mention only a few of the many accomplishments of this Institute in the recent past and only a few of the problems and challenges ahead. Any complete catalogue of either would indeed be exhaustive. Each technical paper marks a step forward, and these approach 1,000 in number during the course of a year. Each technical committee and subcommittee, of which there are almost 250 altogether, is doing an important job in co-ordinating and advancing its particular technical area. Each technical meeting brings hundreds, if not thousands, of engineers together for interchange of technical information and for their professional enrichment. Our area of technical interest taken in its entirety is second to none in its importance to public convenience and welfare. Geographically the territory of AIEE operation embraces our good neighbors both to the north and south, to the enrichment of all. Our code of professional ethics that guides us in our chosen field of work so emphasizes the public welfare and the highest type of personal conduct in relation thereto that each of us can feel the truest pride that we work in and for such a profession.

In this spirit it would be trivial to talk about what this or that person or group has done. Our organization emphasizes team play and, as some players drop out and new ones are added, everyone expects that the team will carry on. I would not want this opportunity to pass, however, without extending my warm thanks and appreciation to those with whom I have been associated in this administration, not just in the Board of Directors but throughout the organization. Their fine co-operation has made it one of my most cherished experiences.

Those of us who are at least in some measure stepping aside salute those who will succeed us and carry on. It is most gratifying to find them so eminently qualified.

To Elgin Robertson, your new helmsman, my congratulations, my sincere best wishes, and my pledge to do all I can to return to him in the year ahead the fine support that he has given me in the year that is now drawing to a close.

If you have allowed me to enter an "A" on the 1952–53 report card I am sure you will agree also that this is indeed a commencement of great promise.

Crystal Growing Furnace

A complete packaged installation for the controlled growth of organic scintillation crystals has been developed by Wakefield Industries, Inc. The crystal growing furnaces are housed in a thermostatically controlled ambient temperature reservoir. Crystals are grown from the melt of any desired luminescent material of melting point between 100 and 500 degrees centigrade by the Stockbarger method. Input power to the furnaces is controlled with Variac transformers, providing good current, and thereby temperature, regulation. The molten phosphor material is transported through a sharp temperature gradient at the rate of 1 inch in 30 hours. All operations and adjustments are carried out from an easily accessible control panel. To avoid confusion all switching operations are indicated separately with color-coded pilot lights. Seed crystal formation and crystal-liquid interface propagation may be directly observed through conveniently arranged windows with internal illumination provided. Facilities for the continuous cooling of the crystalline mass, after crystallization is completed, are available as optional equipment.

The Spirit of Discovery

An Appreciation of the Work of Marconi

Courtesy of Canadian Marconi Company

THERE IS an aspect of the history of great discoveries that has a way of repeating itself—they are often practically applied and utilized before the world of science comes to an agreement on the nature of what has been "discovered." A little over half a century ago, Marconi confounded the science of the time by demonstrating that electric waves, instead of following the laws that govern light and traveling in straight lines, could be made to follow the surface of the earth. He disproved that theoretical barrier to the usefulness of wireless so positively predicted by those who then claimed to understand the "laws of nature." While Marconi did not pretend to understand the phenomenon that he had uncovered, he knew what to do to apply it practically; and he created the art of long-distance signalling without wires. Years passed before the world of science reached agreement as to what it was that he had discovered.

We presently find ourselves in the same position with respect to some of the characteristics of microwaves. We are utilizing discoveries about the propagation of those waves, yet without any agreement as to the mechanism by which they are being transmitted. A set of circumstances such as this is not in itself too unusual. But when we look into the origin of the uncovering of the new phenomenon, we encounter an arresting fact—that it was once again Marconi who, making his third basic discovery in the field of propagation, pointed the way for us. It is seldom that a man makes two basic discoveries. When a man makes three, his attitude toward problems and his method of work merit the closest analysis and study.

It is not often that historical records show the name of a man credited with two basic discoveries. When a man has made three, then his attitude toward problems and how he solved them merit study. Major Armstrong makes such an analysis of Guglielmo Marconi's three great discoveries in the field of radio transmission and reception.

All too little attention has been paid to Marconi's approach and his way of thinking, in part perhaps because of his own natural reticence, but mainly because there has been, in the United States at least, a widespread lack of understanding of the facts about Marconi's discoveries.

My old teacher at Columbia University, Professor Michael I. Pupin, paid tribute to Marconi's first great achievement on the gala occasion when the Institute

Full text of an address on the occasion of the presentation of the AIEE Honorary Membership certificate, AIEE Summer General Meeting, Atlantic City, N. J., June 15–19, 1953.

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welcomed him[1] after the historic reception of the letter "S" at St. John's, Newfoundland, Canada, from the Poldhu transmitter in the British Isles. It was my pleasure and privilege a few years ago to tell the story of Marconi's second fundamental discovery—that of the "daylight wave"[2]—when he found that if "short" waves were made short enough, the 22-year old radio axiom that transmission at night was superior to that by day had to be applied in reverse. On this occasion it is my purpose to pay tribute to Marconi's third great discovery, one made some 20 years ago, but whose significance we are just beginning to appreciate—that even the microwaves, or the Hertz rays of old, curve around the surface of the earth and may be detected far beyond the optical horizon.

In order to put the third discovery of Marconi in proper perspective the earlier discoveries and the work that led to them must be reviewed. That is especially appropriate because of the revival of the Popov claim in recent years in the journals of Soviet Russia. What did Marconi do to succeed where others had failed?

DISCOVERY OF THE "GROUNDED" WAVE*

At the beginning of his interest in the problem of signalling without wires, Marconi proceeded along what might be called conventional lines in his use of the "electromagnetic" wave, with experiments similar to those carried out by Hertz, Lodge, Popov, and other workers. The wavelengths used in that work were quite short, of the order of a few meters, and on occasion, in the centimeter range. Reflectors were characteristic of both transmitter and receiver. By the exercise of great ingenuity in design, and by what must have been consummate skill in the handling and operating of the equipment, Marconi succeeded in increasing the distances over which radio waves could be detected from a matter of a few hundred feet to several miles making use of devices that in form, at least, were essentially those of his predecessors. Optimistically, for Marconi was by nature an optimist, he ventured the hope to extend that range to the hundreds of miles.

Marconi's optimism was criticized by men who were quite sure they understood the laws of nature that applied. Marconi, they said in effect, if he knew the first principles of the electric waves with which he was working, would know that they had the same properties as light waves and so traveled in straight lines; hence, once beyond the horizon, transmission would be cut off. Had Marconi been more of a scientist and less of an inventor, he well might have agreed, concluded that his quest was hopeless, and stopped where he was.

He did not do that. Instead, in the face of the "scientific knowledge" of the day, he went forward with a painstaking series of experiments out of which came the discovery of a new principle. He learned how to attach his radiated electric waves to the surface of the earth by connecting his transmitter to an elevated and to a grounded conductor, and so to guide them around the earth's surface and on to undreamed of distances. He made that discovery, by proceeding in the face of all the rules set up by the "science" of his day.

Comment by one who had worked on the same problem contemporaneously with Marconi but unsuccessfully, is of greater value than that even of the historian, writing after time has silenced the voice of controversy. Hence, the words of Professor Slaby,[3] one of the founders of the Telefunken system, are particularly to the point:

"In January, 1897, when the news of Marconi's first successes ran through the newspapers, I myself was earnestly occupied with similar problems. I had not been able to telegraph more than one hundred meters through the air. It was at once clear to me that Marconi must have added something else—something new—to what was already known, whereby he had been able to attain to lengths measured by kilometers. Quickly making up my mind, I traveled to England, where the Bureau of Telegraphs was undertaking experiments on a large scale. Mr. Preece, the celebrated engineer-in-chief of the General Post-Office, in the most courteous and hospitable way, permitted me to take part in these; and in truth what I there saw was something quite new. Marconi had made a discovery. He was working with means the entire meaning of which no one before him had recognized. Only in that way can we explain the secret of his success. In the English professional journals an attempt has been made to deny novelty to the method of Marconi. It was urged that the production of Hertz rays, their radiation through space, the construction of his electrical eye—all this was known before. True; all this had been known to me also, and yet I never was able to exceed one hundred meters.

"In the first place, Marconi has worked out a clever arrangement for the apparatus which by the use of the simplest means produces a sure technical result. Then he has shown that such telegraphy (writing from afar) was to be made possible only through, on the one hand, earth connection between the apparatus and, on the other, the use of long extended upright wires. By this simple but extraordinarily effective method he raised the power of radiation in the electric forces a hundredfold."

What Popov failed to do was to learn how to attach his transmitted waves to the surface of the earth and so he failed to uncover that vital secret of Marconi's success.

Marconi clearly realized that he had in his possession a new force, the nature and the bounds of which no one really understood. Although no range greater than a couple of hundred miles had yet been achieved, he conceived the bold project of attempting to span the Atlantic Ocean. With a transmitter of far greater power than any before constructed, but which could not have exceeded as an outside estimate 10 kw in the antenna, the attempt was made in December 1901, at St. John's, Newfoundland,† to receive the signals from the transmitter erected at Poldhu. See Figure 1. After some vicissitudes with balloon and kite supported antennas at St. John's, a 400-

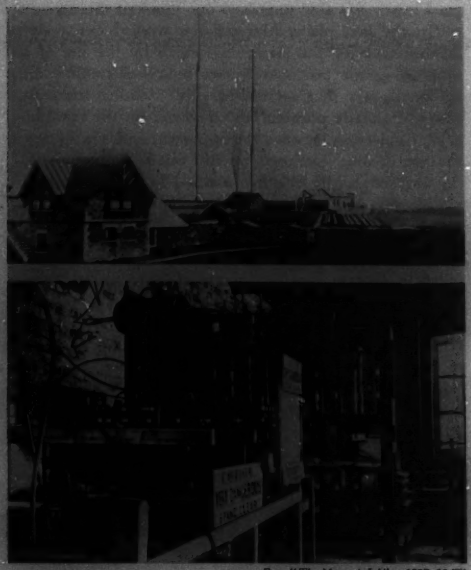
* Subsequently named by Professor Pupin the "Marconi" wave.

† The St. John's site was selected as a substitute for the original plan to establish communication between stations which had been erected at Poldhu and Cape Cod, Mass. The elaborate antenna structures of 20 masts, each 200 feet high, were wrecked during the autumn gales in both places. Poldhu was equipped with a temporary and less effective antenna, and St. John's was selected on the basis of the shortest practical distance across the Atlantic and the freedom of undisturbed experimentation.

foot wire was kept aloft for sufficient periods on successive days to satisfy Marconi and his assistants that they had identified the Poldhu signals. See headpiece.‡‡ Controversy over the accuracy of Marconi's report continued for a time but the Institute accepted his statement and stood firmly behind him. Pupin's remarks recreate the atmosphere of the time. He said:

". . . . . In scientific work we never believe anything until we see a demonstration of it. I believe that Signor Marconi has transmitted the famous three dots across the Atlantic but I must say I believe him because I know him personally. If I did not know him personally I would not believe him because the proof which Signor Marconi has furnished is not sufficiently strong from a purely scientific point of view; but knowing him personally as I do, I believe his statement."

In February 1902, the matter was settled when Marconi, aboard the steamship *Philadelphia*, carried the Poldhu signals out to some 2,000 miles with the limited receiving antenna facilities provided by the ship's masts. It was on that voyage that the difference in range between day and night signalling was first observed, the 2,000-mile range being obtained only during the hours of darkness over the transmission path. The daylight range was only a third as great. That observation was to have a profound effect on the course of the art. Subsequent experiments designed to narrow the gap between day and night ranges led to the use of successively longer wavelengths, and the trend away from the microwaves, which trend began when Marconi attached aerial and ground to his equipment, continued. It was destined to continue for over 20 years.



From "The Marconi Jubilee, 1897–1947"

Figure 1. Antenna and transmitting equipment used at Poldhu in 1901

The observations on the *Philadelphia* were followed by a long period of experimentation and construction, work that testified eloquently to a faith and a determination reminiscent of the faith and determination of those who laid the first Atlantic cable. Finally, in 1907, two transatlantic wireless stations with greatly increased power were completed and put in operation; one at Clifden, Ireland, and the other at Glace Bay, Nova Scotia. In these days, when millionfold energy amplification of the faintest of radio currents is a commonplace in home radio sets, it is in order to restore the perspective by pointing out that no faintest dream of an amplifier, even of the audible-frequency currents, existed to encourage the efforts of those who faced the problem of transoceanic signalling. The energy that moved the diaphragm of the telephone receiver was limited strictly to that which could be abstracted from the wave, an amount often so pitifully small that the act of breathing obliterated the operator's ability to perceive the signal. The next half-dozen years were the Dark Ages of radio communication, and Marconi, in common with others in the field, fought through them, until the appearance of the regenerative circuit, practical heterodyne reception, and the high-power arc and alternator, and ultimately the pure electron discharge vacuum tube, brought on the era of modern radio.

Then a new problem came into being—the problem of the static. So sensitive had receivers become that the feeblest of signals could be brought up to a readable strength and communication could be carried on over very great distances during periods of favorable transmission when static was absent. But when static was present, even on levels that previously would have passed unnoticed, it became evident that it was going to be the major factor limiting communications. So the art moved in the direction of still higher powers for transmitters, which meant still longer wavelengths where the static was worse and the size and cost of antennas was much greater.

By the end of World War I, large amounts of capital had gone into the development of high-frequency alternators in the various countries (Alexanderson in the United States, Von Arco and Goldschmidt in Germany, and LaTour in France) and the long-wave vacuum-tube generator was making its appearance in the British Isles. Waves of 10,000 meters were the order of the day; and to radiate them effectively, very costly antenna structure was required, some approaching 1,000 feet in height and a mile in length. The business of transoceanic communication could not be carried on without capital investments of major proportions. Powers of the hundreds of kilowatts and the improved receiving means made it possible to operate perfectly during the undisturbed periods of the early morning hours, but with the coming of atmospheric disturbances in the afternoon and evening, originating in the electrical storms of the tropics, reception from even

‡‡ Signor Marconi, extreme left, supervising the launching of the antenna-supporting kite at St. John's, Newfoundland.

the highest powered transmitters was frequently blotted out. During such periods the brute force method all too often failed to match up to the forces of nature.

We were quite satisfied with the working of our transmitting and receiving equipment, which operated well in the absence of disturbances; and the idea that we were doing the wrong thing never entered our heads. That there might be some way of working with an unknown force of nature, rather than against those presently known, appears to have been beyond the imagination of those in the art at the time. Another basic discovery was required to get off the dead-end road. Moving amidst a competition now increased multifold beyond that of his early days, it was nevertheless Marconi's destiny to make that discovery, but only after the chance to make it had been repeatedly missed—by him and others—for nearly 3 years.

DISCOVERY OF THE "DAYLIGHT" WAVE

IT WAS my privilege some years ago in a talk before the Western Society of Engineers to present the full story of that accomplishment, and the following account abstracts the essential facts from it.

The ending of World War I released the experimental energies of a very able engineer of the British Marconi Company, C. S. Franklin. Following up some work of Marconi for the Italian Army with short-wave directive beams, Franklin established a telephone circuit between London (Hendon) and Birmingham in 1920, on the extremely short wave of 15 meters. That wavelength was chosen, not for any expected advantage in transmission, but because it was easy to set up a reflecting antenna for waves of that order, and because loss of range, that is, the "daylight effect," does not occur over so short a transmission path (100 miles). The Hendon and Birmingham transmitters had effective radiated power of about 4 kw, and the system worked well. The significance of the Hendon-Birmingham circuit in this chapter of radio history will appear presently.

THE FIRST TRANSATLANTIC S-W SIGNAL

THE RADIO amateur comes into the story at this point. American and British amateurs had been talking for years about organizing a test to determine whether the wavelengths on which they were allowed to work, the commercially "useless" ones of 200 meters and under, could span the Atlantic—during the hours of darkness, of course. Such a test was finally organized in 1920, on the amateur's standard wavelength of 200 meters. It failed. In the next year, another test was organized. Though all prophecies were that it too would fail, in fact a score of United States amateur call-letters were identified in the British Isles in December 1921, two of them from stations with power of less than 100 watts; and one of the stations, Station *1BCG*[4] in Greenwich, Conn., succeeded also in transmitting a complete message.

But the signals could be received only during the night hours of the Atlantic path; they ended with sunrise at its eastern end and did not reappear until after sunset at its western end. While the results caused a flurry of interest for a time, it soon died down. Though everyone was surprised that a 200-meter wave could span the Atlantic, neither the commercial companies nor those who took part in the tests were stimulated to investigate the shorter waves further. I had a hand in the construction of the *1BCG*[4] transmitter and also in the decision to dismantle it after the test, when the question of further investigation was discussed. But why investigate something with so fatal a defect, a telegraph system that could work only part of the time? Marconi seems to have been the only man in the commercial field whose imagination was fired with the spanning of the Atlantic by the stations of the amateurs.

From "Journal," Royal Society of Arts

Figure 2. The yacht Elettra on the voyage to Cape Verde Islands

In a paper presented before the AIEE and the Institute of Radio Engineers in New York, N. Y., in June 1922,[5] Marconi told about some of his recent work in radio, including the work for the Italian Army with directive beams and the 15-meter Hendon-to-Birmingham telephone circuit. He suggested that radio perhaps had gotten into a rut by confining practically all its research to the long waves, and that more attention should be given to the shorter waves; and he summed up his remarks on the subject with these prophetic words: "I have brought these results and ideas to your notice as I feel—and perhaps you will agree with me—that the study of short electric waves, although sadly neglected practically all through the history of wireless, is still likely to develop in many unexpected directions, and open up new fields of profitable research."

THE CAPE VERDE ISLAND CRUISE

UPON HIS return to England, Marconi began a series of experiments from the historic Poldhu site, which took him on a cruise in his yacht *Elettra* to the Cape Verde Islands in the South Atlantic during the spring of 1923. See Figure 2. He had set up a transmitter at Poldhu (see Figure 3) on the longest "short" wave for which it was then practicable to build a reflecting beam antenna, about 100 meters,§ with an effective power in the beam of about 120 kw. He listened to the Poldhu signals as he cruised south, and found them to be extraordinarily good at night. The daylight signals disappeared at about 1,400 miles but at night in the Cape Verde Islands over 2,500 miles from the transmitter, they were far better than any signals that ever had been received over a comparable

§ The Poldhu wavelength during this voyage was 97 meters.

distance from a high-power long-wave station. Marconi reported[6] that, even when the power at Poldhu had been reduced to 1 kw, the night signals were still better than those received from the highest powered transoceanic stations in the British Isles. While the usual disappearance of the signals during daylight hours occurred, Marconi observed that the signals lasted for a time after sunrise at Poldhu and became audible again before darkness had set in at the Cape Verde Islands. At that time of year, the sun rose at Poldhu about 3 hours earlier than at St. Vincent, where the yacht was moored.

Marconi's observation led him to suspect that some new phenomenon was present in the short-wave band, something quite different from the normal effect he had observed for years at sunrise on long-wave reception across the North Atlantic. After his return to England, he laid out a program of further experimentation for the following year, when he would compare the signals at 90 meters with those on a number of shorter wavelengths, down to the region of 30 meters. In the summer of 1924, he cruised through the Mediterranean to the coast of Syria; and in Beyrouth Harbor in September of that year, he made the astounding observation that the signals on the 32-meter wave from Poldhu, some 2,400 miles away, held in throughout the day;[7] that in fact they were as good as the night-time signals, whereas a longer wave of 92 meters, on the same power, behaved as at the Cape Verde Islands. What Marconi was observing was transmission by reflection from that ionized layer of the upper atmosphere which later became known as the F_2 layer, after years of observations had laid bare the mechanism by which the effect was produced. But as with Marconi's first discovery, his practical achievement was years ahead of the theory.

Returning to England within a month's time, Marconi sent notification of scheduled transmissions on 32 meters to Argentina, Australia, Brazil, Canada, and the United States; and at the appointed times, the daylight signals were received in all those countries. From the end of the earth, Australia, came a report of successful reception for 23½ hours of the 24.

These results become still more astonishing when it is remembered that Marconi was using only a small percentage of the power of the transoceanic long-wave stations, and was unable to take advantage of his directive beam antenna because of the diversity of the paths of transmission to the various receiving points.

As sometimes happens with radically new discoveries, the significance of Marconi's results was not generally appreciated, at first, outside his own organization. As in the case of his original discovery, what he had done was too far out of line with established teachings to be accepted in advance of a physical demonstration of the result. But while others hesitated, Marconi, supported by the brilliant engineering of Franklin, moved rapidly, and by the end of 1927 short-wave beam transmitters were operating between England and all the principal parts of the Empire, and at speeds (100 words per minute) that no long-wave transmitter or cable ever had approached. The long waves were obsolete; and the cables were on the way to becoming a secondary means of communication.

Today, all but a few per cent of the world's long-distance radio communication is carried out on wavelengths less than one quarter the length of the waves originally allotted the amateurs in the 200-meter range. Perhaps the best measure of the advance from the era of the "grounded" wave is that it is now commonplace for amateurs the world over, with a few hundred dollars worth of equipment, to communicate with one another, and the "working" of several continents in a single day is no longer the subject of comment.

Both the British Marconi Company and the Telefunken Company recently issued 50th anniversary books, beautifully illustrated with pictures of the high-power long-wave transoceanic stations of the early 1920's. A comparison of them with a photograph of a present-day trans-world short-wave station or even of a modern American amateur station testifies, more eloquently than any words can, to the power of the right idea.

MISSED CHANCES

We can return now to the Hendon-Birmingham beam already described and contemplate the moral of the

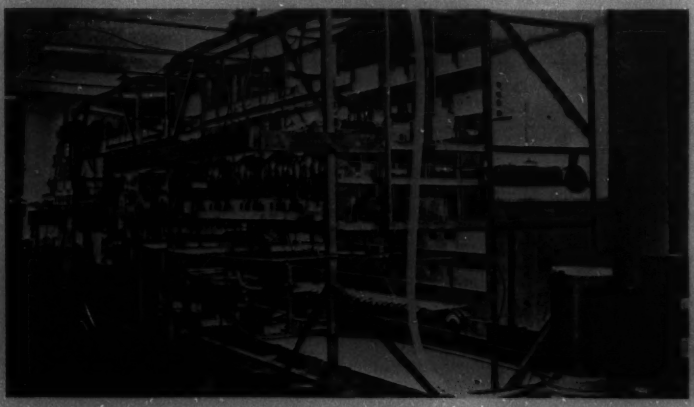


Figure 3. The Poldhu beam transmitter in 1923. The interior is shown on the left and the exterior of the experimental station is pictured below

From "Journal," Royal Society of Arts

story of one of the great missed chances of radio history, the chance that every American amateur and radio experimenter had had to tune in the Hendon-Birmingham beam telephone as early as 1922 and discover the daylight wave before Marconi. The Great Circle course of the Hendon beam lay across eastern Canada and the United States. The 15-meter wave, as was found later, was a better daylight wave than those in the 30-meter range, though it was not effective at night. Full information about the Hendon station was available from Franklin's and Marconi's publications, and all necessary information about the most effective means of receiving such waves, the superheterodyne, had been published.

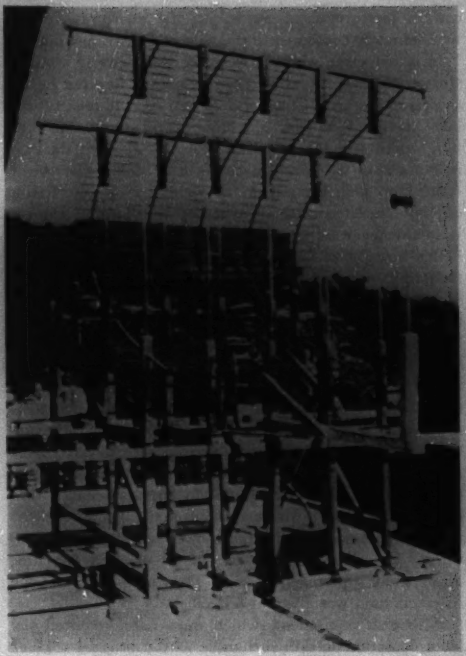
Had any radio experimenter in the United States thought to set up a superheterodyne for 15 meters and listen for the Hendon signals during the daytime, he almost inevitably would have heard them at some time during the day, and he, instead of Marconi, would have discovered the daylight wave. But no one had the imagination to set up a receiver and listen. We all "knew" too much about propagation; only a madman in those days would have proposed to receive 15-meter signals across the North Atlantic, especially during daylight hours.

There is, however, a consolation for the American experimenters who missed the chance. The master experimenter, Marconi, also missed it. Though for more than 20 years he had made it a practice on voyages to the United States to take along receivers to listen to his British stations, when he crossed the Atlantic in the *Elettra* in 1922 it seems not to have occurred to him to take along a 15-meter receiver and listen to Hendon. Had he done so, and turned the Hendon beam to follow the yacht, he would have discovered the daylight wave 2 years before he actually did.

It is important at this point to call attention to a strange and disquieting circumstance, the failure among our writers of history and our textbooks to tell the story of this great discovery correctly and to credit Marconi with making it. There are great lessons to be learned from his accounts of the two voyages of the *Elettra*, and the facts have been available, yet our literature on the subject has been either completely silent or downright incorrect.

Two outstanding instances appear from the history of this development which reveal Marconi's intuitive sense of what to investigate and where to look for new results. The crossing of the Atlantic by the large number of amateur signals, some of them of extremely low power, meant something more to Marconi than quite evidently it did to the rest of us. He went ahead with his investigation. His observation of the signals in the Cape Verde Islands revealed that the daylight fade and the nighttime rise did not behave in accordance with his previous experience with long-wave signals.‖ In his July 1924 Royal Society paper the phenomenon was described, and in the discussion Marconi correctly diagnosed the limits of his own knowledge. He stated in response to questions that he did not know whether some other wavelength might not perhaps cover great distances in the daytime. So he made

‖ Sunrise at Poldhu occurred 3 hours earlier than at Cape St. Vincent.



From "Proceedings," Royal Institution of Great Britain

Figure 4. The 60-centimeter beam transmitter and antenna

the experiment and found the answer. The rest of us knew too much about the laws of nature to try.

THE "BENDING" OF THE MICROWAVES

THE THIRD TIME when Marconi pointed the way to a new form of propagation of electric waves was in the summer of 1932. A new approach to short-wave communication had been taken, with a microwave beam powered by a continuous-wave generator, in March 1931, when the Standard Telephones and Cables Company of London and Le Material Telephonique of Paris demonstrated communication across the English Channel (Dover to Calais) on a wavelength of about 20 centimeters. Radio was back in its original waveband, with its parabolic reflectors small enough to fit into an average sized room, but with the important substitution of the vacuum-tube generator for the spark oscillator and an enormously more sensitive vacuum-tube receiver for the coherer devices.

The increase in distance over the original microwave transmission range of a few miles was hardly as impressive as one might have expected, considering how far the art had advanced in 3 decades, although the reliability of the service unquestionably was. The cross-Channel work was accepted by the radio world for what it was—line-of-sight transmission following the characteristics of a searchlight beam; and when bad fading was encountered during

certain meteorological conditions, the microwave region was definitely consigned to the field of short-range links.

It is not clear whether Marconi was actively working with centimeter waves at the time or was inspired by the success of the cross-Channel demonstration to look further into them. Whatever the motivating force, we find him working in the following year (1932), with the able assistance of G. Mathieu, with a 60-centimeter beam located on high ground in the vicinity of Rome, testing out for himself once again whether the "laws of nature" were as they were supposed to be. Once again we find in his account of his work the same painstaking experimentation, the same awareness that he did not know the answers, although others already were satisfied that they did. While others extrapolated observations into theories, Marconi worked with his apparatus and let the results speak for themselves. See Figure 4.

The only satisfactory continuous-wave generator available for the frequency with which he was working appears to have been the Barkhausen-Kurtz type; but the available tubes, when pushed for power, proved to have a life measured by minutes. Marconi had new tubes developed, adjusted to fit into circuits and to operate reliably with increased power. With several units in parallel, he appears to have obtained an effective power of the order of 10 watts. His receiver made use of an electron oscillator arranged for superregeneration. The gain of the parabolic reflectors used was given at 8 decibels.

With that equipment, which must have required the same consummate skill to handle as the original coherer spark equipment, he once more found that difference between experimental fact and accepted theory which he had encountered twice before. Having installed his transmitting equipment atop Rocca di Papa, an elevation of some 2,500 feet above the Mediterranean Sea, he steamed away on the *Elettra* through areas of varying signal strength receiving the last faint signals at a distance of 125 miles, where the receiving antenna was at least 1/2 mile below line-of-sight transmission. Continuing on to Golfo Aranic, Sardinia, he disembarked the receiving equipment and installed it on the tower of the signal station at Cape Figari, 340 meters above sea level. Although the distance was 168 miles, and the receiving station over a mile below line of sight, 100-per-cent intelligible speech was received during the strong periods of the signal, which varied in strength from completely intelligible reception to inaudibility in slow deep fades.

Marconi announced his discovery of the bending of the waves, but it was received with skepticism. The line-of-sight theory of transmission of centimeter waves was too firmly ingrained to be disturbed by one experiment, even when the experimenter was Marconi himself. I well remember that my own reaction to his announcement at the time was similar to that when the rumor of the discovery of the "daylight wave" was in the air. It was against the laws of nature as I knew them, and hence it was not conceivable that it could be true. Perhaps some of the rigidities of the mind of the engineer would be eased a bit by more frequent reference to a few words set down some centuries ago: "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy." (Hamlet) Today, we know Marconi was right; but nearly 2 decades passed before the words of his prophecy at the time came true. Ill health and the end of his career terminated further exploration of the new mode of transmission; but he left the vision, and his own words present it as he saw it. In the conclusion to his paper[8] he said:

"In regard to the limited range of propagation of these microwaves, the last word has not yet been said. It has already been shown that they can travel round a portion of the earth's curvature, to distances greater than had been expected, and I cannot help reminding you that at the very time when I first succeeded in proving that electric waves could be sent and received across the Atlantic Ocean in 1901, distinguished mathematicians were of the opinion that the distance of communications, by means of electric waves, would be limited to a distance of only about 165 miles. H. M. Poincare—Notice sur la telegraphie sans fil. Annuaire pour l'an 1902 des bureaux des longitudes—Paris."

When we remember the low power available for transmission and the crudeness of the equipment with which Marconi accomplished the 168-mile transmission, and consider the incomparably superior equipment that has been available to us from the technical developments of World War II, the wonder is that his prophecy went so long unheeded, and that the investigations of the past few years were so long deferred. Certain it is that, with the tools at hand, we have taken a long time to catch up with the prophecy.

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Gas Turbine for Compressed Air

A 1,800-horsepower gas turbine-compressor has been installed in a trailer for tests to determine its suitability for supplying compressed air. The gas turbine, two multistage centrifugal air compressors, a 50-horsepower starting motor, and a 60-kw generator and auxiliaries are mounted on a fabricated steel bedplate. The plant requires only two external connections for starting, electric power for ignition and motor-driven auxiliaries, and distillate fuel for the gas turbine. The open-cycle gas turbine develops more power per unit of weight and volume than any other type of prime mover and is ideally suited for a mobile unit.

Open-Loop Frequency Response Method

K. L. COSGRIFF
ASSOCIATE MEMBER AIEE

SERVOMECHANISM DESIGN and test procedures which are based upon the assumption of system linearity are not satisfactory for many servos. This problem has been summarized in a recent article in this magazine.[1] A method for representing the open-loop frequency response of nonlinear systems will be considered which indicates the presence of most nonlinear phenomena of closed-loop systems.

Consider the system shown in Figure 1. Block G is considered to be nonlinear. If the input to block G is excited directly and is of the form

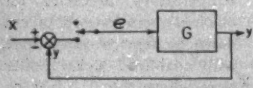

Figure 1. Block diagram of typical nonlinear servo

$$e = c_1 \sin(\omega t + \theta) \tag{1}$$

then the output y will be of the form

$$y = b_0 + b_1 \sin\omega t + b_2 \sin(2\omega t + \beta_2) + \ldots \tag{2}$$

In the closed loop system e is the error and is equal to $x - y$. If the input x is made equal to the sum of e and y, or

$$x = c_1 \sin(\omega t + \theta) + b_0 + b_1 \sin\omega t + b_2 \sin(2\omega t + \beta_2) + \ldots \tag{3}$$

the error e and output y will be the same as equations 1 and 2. The fundamental component of the input can be written in the complex form

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Values for c_1, θ and b_1 obtained from the open-loop response determine points in the complex $X(j\omega)$ plane. These points will have a meaning if c_1 and θ are evaluated for a set of values of ω and b_1. After these points have been plotted, one smooth curve can be drawn through each set of points determined by one particular value of b_1. Similar curves can be drawn through each set of points corresponding to a particular frequency. An example of this representation is shown in Figure 2*a*. Consider point P. This point indicates a fundamental output of unit magnitude for a fundamental input magnitude equal to the radius of point P. It also indicates a frequency of 0.1 radian per second and shows that the input fundamental leads the output by an angle ψ.

Consider point P of Figure 2*b*. This point indicates that an output with a component of the form 0.8 sin 0.4t can exist without a fundamental input term. This means that the system has a limit cycle. The limit cycle is stable. Point P of Figure 2*c* also falls on the origin and it indicates an unstable limit cycle. The stability of the limit cycle is generally determined by the positive or negative value at the point at which the smaller b_1 locus crosses the real axis.

Another phenomenon is indicated by Figure 2*d*. The fundamental input to the system with a frequency of 1 radian per second can be slowly increased in magnitude until it is equal to the radius r. The output is then determined by point P_1. If the input becomes larger than r the output is determined by a point near P_2 for there is no point near P_1 on the $\omega = 1$ locus. The radius of point P_2 is the same as that of P_1. Notice that the output changes from 1 to 1.25 and that the phase also jumps in value as the input becomes larger than r. This is often called a jump phenomenon.

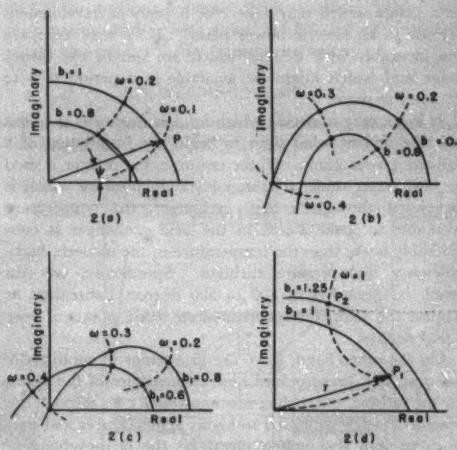

Figure 2. Plots of X(jω) illustrating nonlinear phenomena

(*a*) *Typical servo*
(*b*) *Servo with stable limit cycle*
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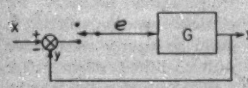

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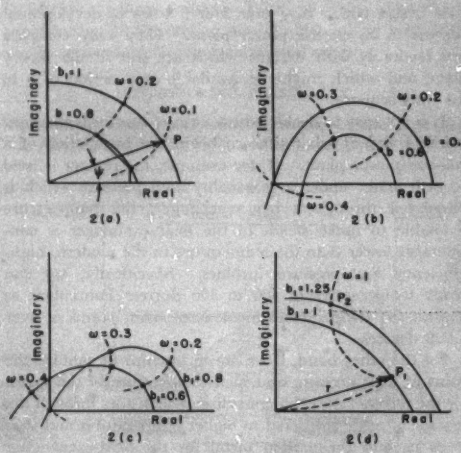

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Present Feasibility of a Nuclear Power Plant

T. G. LeCLAIR
FELLOW AIEE

On December 20, 1951, 100 kw was generated in an AEC nuclear power plant at Arco, Idaho, using the heat of an experimental breeder reactor and on February 24, 1953, at Oak Ridge, Tenn., 150 kw was developed in the Government's homogeneous reactor experiment. These two practical demonstrations showed the technical feasibility of producing electricity in a nuclear power plant.

THERE ARE various types of reactors which could be used for the generation of electric power. Industrial study teams in the United States have been analyzing the prospect for development of several of these types of reactors. These teams have come up with what appear to be divergent answers on the present state of the art. Actually their opinions are not as divergent as they appear on the surface. Some of the forms of reactor could be built with the present technology and operate quite satisfactorily. These reactors may not, however, be quite so efficient as a design which may take 2 or 3 years of development for use in an electric power plant. They may compare less favorably with designs which are still in the theory stage and which might be available in a period of 5 to 10 years or more.

It is not easy to decide which form of reactor is the most suitable and at what time to begin the installation of a full-size power plant. If, for example, the reactor is used to heat water under a reasonably high pressure which is circulated through a heat exchanger, the temperature available to make steam in the heat exchanger is considerably lower than the temperature in the modern, high-efficiency high-pressure turbines. Specifically, we can reach temperatures of 400 to 500 degrees Fahrenheit as against the temperatures in modern steam plants of over 1,000 degrees.

On the other hand, if we are to attempt to capture the gains of high pressure and high temperature of the steam for the turbine, the cooling medium which goes through the reactor must be subjected to higher temperatures and that leads us into the molten metals as the heat-exchanging medium. The high boiling-point temperatures of liquid metals makes them very attractive. However, molten metals, particularly those like sodium which will not be damaged by radioactivity, have other properties that make them very difficult to handle. One of these is the extremely corrosive nature of some of the metals that have the desirable physical characteristics. Another is the tendency of molten metals to solidify when a reactor is shut down with resultant freezing problems.

If we use the type of reactor which pumps the reactive material itself out of the reactor and into the heat exchanger, then the heat exchanger is subjected to radiation which may cause corrosion and leakage problems extremely dangerous from the health standpoint. Good engineers can solve all these problems but can they solve them in such a way that the costs of power from the reactor plus the heat exchanger, for the temperatures necessary for efficient operation, will be cut down to figures competitive with coal-fired steam boiler plants? There is every reason to believe that this can be done ultimately, but when is unknown.

The variety of solutions of the problem which are possible have resulted in statements being made all over the country favoring each of several different basic designs of reactor. There is some reason to believe that most of the designs could prove ultimately to be economically successful. We in the Commonwealth Edison–Public Service study group favor, as an initial development, the use of a simple form of reactor with a solid metal as a fuel and using heavy or light water as the coolant. The reoson that we favor this form now is that it appears possible to go ahead with the design of an electric plant promptly without waiting for the solution of some of the more difficult problems of handling molten metals and radioactive materials at elevated temperatures. It very well may be that this form will be less economical 10 years from now than one of the other reactors, but progress usually is made by doing rather than theorizing, and the time will come when a plant must be built in order to meet some of the problems head on and solve them by actual operating experience. Also, many periods of a decade in the development of today's coal-fired boilers have seen radical increases in efficiency—and the older boilers were retained in service for their physical lives, merely being relegated to lower load-factor service.

A SUITABLE REACTOR DESIGN

THE Commonwealth Edison–Public Service team decided early in its study to concentrate on designs which could be constructed and made to operate promptly. Two such designs were contained in an informal report made to the Atomic Energy Commission (AEC) in May 1952 and the major features released for publication. A third design has not yet been released. An abbreviation of the design using solid fuel elements and heavy water

Full text of a conference paper presented at the AIEE Summer General Meeting, Atlantic City, N. J., June 15–19, 1953.

T. G. LeClair is manager of engineering, Commonwealth Edison Company, Chicago, Ill.

for coolant and moderator will serve to illustrate a plant which we believe could be built with present technology. See Figure 1.

The Reactor. The reactor contemplated would use fuel elements made of natural uranium. Heavy water is planned as moderator, reflector, and coolant. The reactor control system consists of a number of boron steel control-rod assemblies so constructed and installed that they may be actuated by a servomechanism to regulate heat output and meet safety requirements. Cladding on components of the reactor core would be of thin zirconium metal or stainless steel, as functions and exposures may require. See Figures 2 and 3.

Thermal Shield. The thermal shield of the reactor in this design consists of a stainless-steel cylindrically shaped casing surrounding all of the components of the reactor core.

Biological Shield. Safety and protection for those who may work around the reactor is provided by a mass of reinforced concrete, 8 feet thick. Other elements in the plant which require shielding will be covered with concrete or lead, as circumstances dictate.

Heat Output. It is anticipated that this heavy-water cooled and moderated reactor will be capable of producing 1,064 megawatts of heat power for conversion to steam through heat exchangers. See Table I.

Heat Exchanger. To get the most effective heat exchange possible, 18 heat exchangers are proposed to handle coolant flowing at a velocity of 15 feet per second through "U" tubes in each of these steam generators. These tubes, in turn, are surrounded by light water needed for steam production. Heat losses for all practical purposes are negligible. See Figure 4.

Turbogenerators. With respect to the turbogenerators and accessories, steam conditions and commercial availability dictate the use of generators rated at 80,000 kw when operating at 80-per-cent power factor. See Table II.

In summary, such a central station nuclear power plant would have one large reactor delivering 1,064,000 kw of heat to 18 steam generators. The steam would approximate 3,240,000 pounds per hour at 175 pounds per square inch absolute and 371 degrees Fahrenheit, serving three 80,000-kw turbogenerators. With auxiliary power approximating 20,500 kw, a net 211,500 kw of electricity would be available to the transmission system.

Table I. Design Criteria and Specifications for Steam Generators

Capacity, pounds per hour (one unit)	180,000
Number of units	18
Steam:	
Flow (total at 2.5 inches mercury), 10^6 pounds per hour	3.25
Pressure, pounds per square inch absolute	180
Purity, parts per million	1
Temperature (saturated) degrees Fahrenheit	373
Feed water:	
Preheater inlet temperature (2.5 inches mercury) degrees Fahrenheit	109
Preheater outlet temperature, degrees Fahrenheit	373
Coolant:	
Design pressure, pounds per square inch absolute	800
Flow, 10 pounds per hour	64.50

Table II. Turbogenerator Design Data

Steam pressure at turbine throttle, pounds per square inch absolute	175
Steam temperature (saturated) at turbine throttle, degrees Fahrenheit	371
Exhaust pressure:	
Design, inches mercury	2.5
Operating, inch mercury	1.0
Steam flow:	
With 2.5 inches mercury back pressure, 10^6 pounds per hour	3.21
Standard 80,000-kw generator (13.8 kv, 1/1 in pounds per square inch gauge H_2, 1,800 rpm)	5

ENGINEERING FEASIBILITY

THERE IS little doubt that a reactor of the type just described could be built at the present time in a size

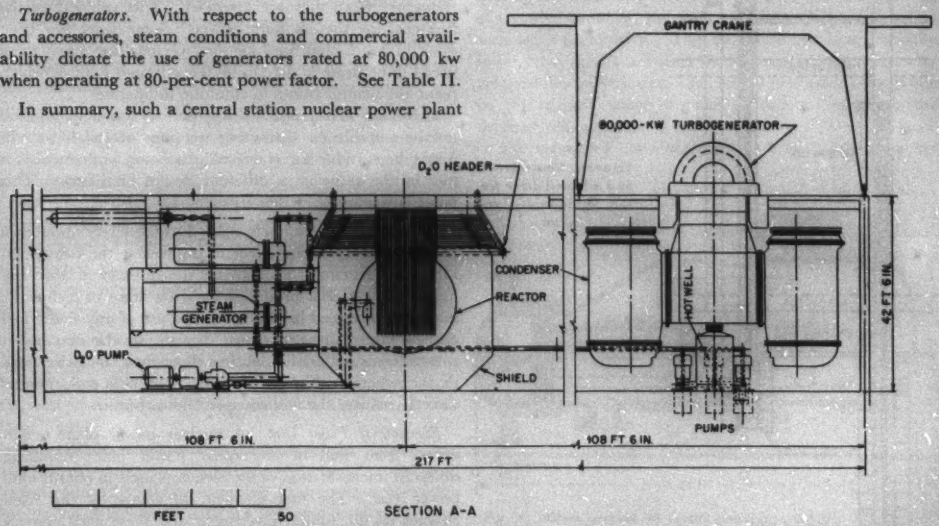

Figure 1. Sectional view of a liquid-cooled reactor plant

suitable for a large power system and could be made to operate either primarily for electric power or for power plus plutonium of weapons grade. Reactors already built of similar designs, of small size, are operating and have proved that solid-fueled water-cooled reactors will operate. There are some engineering problems, of course, in connection with taking the step to a much larger size. One of these problems is the building of a pressure vessel large enough to contain the reactor core. The heat exchangers or steam generators involve some new features on which the manufacturers already are working and are satisfied that they can be built with assurance of success.

It is recognized that the other types of reactor, such as those using liquid-metal coolant or homogeneous fuel, inherently lend themselves to better economy. However, the country can gain from learning the lessons in connection with the full-scale plant by building one of the type described without waiting to solve all the research problems of a future design. This situation is no different from the question of building television sets for black and white for commercial service while we still are working on the problems of color television for a future market.

ECONOMIC FEASIBILITY

All nuclear reactors constructed to date have been for either military purposes or for the development of a completely new art. In such instances it is not surprising that the first essential is to solve the technical problems, with less attention to cost. It is not practical to expect the first designs to be built at a cost which would be competitive with any conventional source of electric power. For a submarine it is far less important to know the cost per kilowatt of power developed than to know that the submarine can operate for a long period without refueling.

For a nuclear power plant to deliver electric service in competition with water power or coal power, the situation is radically different. The ultimate goal must be to produce electric power at a competitive cost. Consequently, there is a transition to be made between the present state and the ultimate: straight competitive power conditions.

Dual-Purpose Plant. A reactor power plant of the type described can be used to produce plutonium of grade suitable for weapons and at the same time to utilize the heat for the production of steam for electric power. A reactor for the production of plutonium as well as power might cost very little more than a reactor producing power only. The economics of a dual-purpose plant are tied to the value of both plutonium and power. At present values, the dual-purpose plant would appear to be economical.

There is doubt in the minds of all of us that we will have a continuous high value for plutonium over a 30-year period. Therefore, the design described was made so that the plant could operate to produce either power plus plutonium or power alone.

Fuel Burn-up. For the production of plutonium the fuel is left in the reactor for a relatively short time before it is removed for chemical processing and extraction of the plutonium. Practically all operating experience to date with large reactors has been with this background.

If the reactor plant is to produce electric power only, the goal is to extract as much heat as possible from the fuel elements before they are removed. This will reduce the fuel cost for the resultant power. Some work has been done in irradiating fuels for long periods but much more needs to be done to determine the ultimate limit at which point the reactor ceases to continue to operate.

If the fuel is fissioned for long periods apparently it will not be suitable for extracting weapons material but still might be suitable for chemical processing and reuse as a fuel in the same or a different design of reactor. This point is worthy of further study.

Conversion Ratio. Closely related to the effect upon costs of fuel burn-up is the effect of improving the conversion ratio of a reactor. To increase the number of atoms of fissionable material produced for each atom of fissionable material consumed is to prolong the use of any single fuel charge placed in a reactor. Increasing the conversion ratio extends materially the time that a fuel charge remains in the reactor without losing its reactivity and thereby directly reduces the fuel cost per kilowatt-hour.

Elements of Power Cost. A nuclear power plant design differs from that of any other power plant requiring different interpretation of the elements used to obtain total power cost. The first element, of course, is the fixed charges on the capital investment and these fixed charges will vary not only with the amount of capital investment

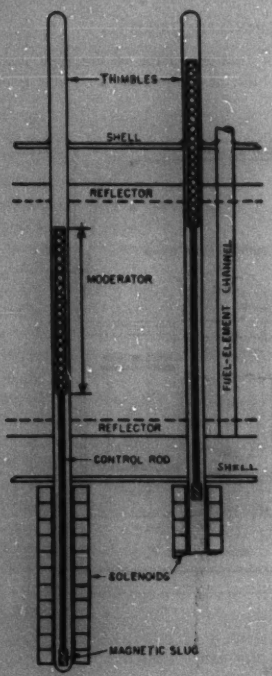

Figure 2. Control rods and solenoid drive for the liquid-cooled reactor

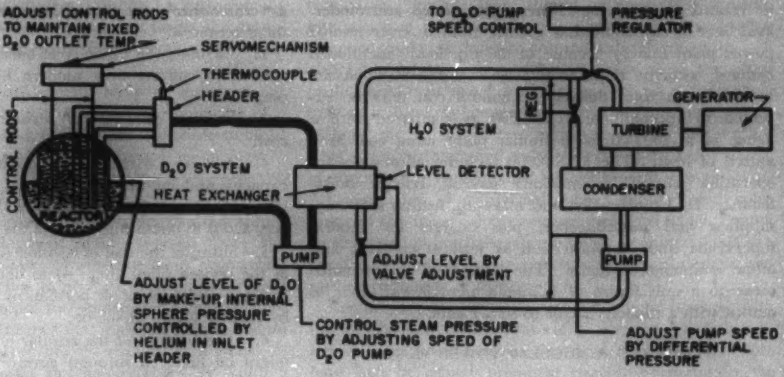

Figure 3. Basic control functions of a liquid-cooled reactor, heat exchanger, and turbine

but with the estimated useful life of this capital plant before it is either obsolete or depreciated.

The second element in cost is the fuel used. In the case of a reactor plant this fuel cost is the value of the fissionable material which is used for a straight power plant or is the difference between the value of the initial fuel and the irradiated fuel in the event of production of plutonium. This difference may be either a positive or a negative quantity depending on the price of plutonium.

The third factor is the operating cost including labor and maintenance.

Capital Investment. When estimates are made of capital investment in plant, buildings, and equipment, such estimates include the reactor and associated costs, the steam generating plant, the turbogenerator plant, the structural and plant site, miscellaneous power plant equipment, the electric plant, and the transmission plant.

These items of investment are subject to unique treatment due to the legal, biological, and nuclear considerations inherent in the structures under consideration.

Operating Costs. Operating costs likewise are significantly influenced by the use of nuclear fuel. National security, a Federal mandatory requirement, creates a manning and policing problem.

Entirely new devices and techniques must be evaluated when looking at the possible costs of maintenance and operation of a reactor. The possibility of radioactivity in the electric plant and elsewhere on the property creates areas of unknown danger and the need for costly preventive measures.

Fuel. Fuel cost determination requires new thinking. If the fuel is converted to plutonium, it may have a higher value after use than before. On the other hand, the cost of disposing of fission products may be a very large item.

Accounting, miscellaneous items, and other administrative requirements in connection with fuel, products of fission, and other things resulting from reactor operation are no small factors in deriving probable total costs in an economic study.

TYPICAL ECONOMICS

With such realistic factors in mind as well as others more generally used by those in the electrical utility industry, let us look at an illustrative problem. An estimate of the investment required in a nuclear power plant of 211,500 kw capacity, using a heavy-water cooled and moderated reactor, would be approximately $78,000,000, excluding investment in fuel inventory. This, in effect, means an investment cost of $370 per net kilowatt of installed capacity.

A substantial portion of this cost arises from very conservative measures to provide protection against radiation hazards to meet probable requirements of the Reactor Safeguard Committee.

When compared with conventional power plants requiring an estimated investment of $200 per net kilowatt of installed capacity, the $370 for the nuclear power plant may seem prohibitive. This estimated cost is appreciably lower than the figures used in the original report recently released for publication. Modifications have been made in this design which appear to warrant reducing the original cost estimate.

The estimated costs of operating and maintaining the

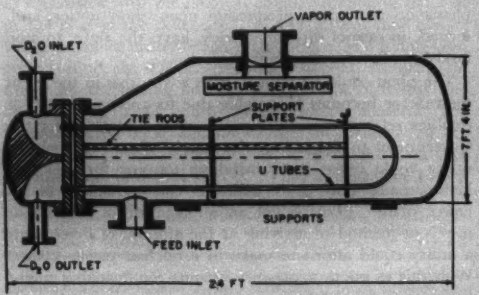

Fig. 4. Cross section of steam generator for the liquid-cooled reactor

referenced plant having a heavy-water cooled and moderated reactor are somewhat greater than a conventional power plant mainly because of the previously mentioned Federal security requirements and the health physics involved. In total dollars the annual cost may be expected to approximate $1,700,000 as compared with a figure of $1,200,000 for a similar plant using coal as a source of heat. The $1,700,000 includes allowances for operating payroll, maintenance payroll, reactor maintenance, D_2O purification and make-up, helium make-up, supplies, and miscellaneous, plus charges for general supervision and administration as well as contract and other maintenance items. The labor and maintenance come to a unit figure of 1.2 mills per kilowatt-hour of output with a capacity factor of 80 per cent.

FINANCING A NUCLEAR POWER PLANT

UNDOUBTEDLY, many possible methods could be developed for financing a nuclear power plant. The methods of financing would be materially affected by whether or not the Atomic Energy Act of 1946 is revised. Under the present terms of the Act, the Atomic Energy Commission is the only agency which may own a reactor or own fissionable materials or fission products in any sizable quantities. Without commenting on the desirability of changing the Act, it is perhaps worth while to mention just two of the possible methods of financing a reactor power plant.

Assuming that the present law remains in effect and also assuming that a desirable objective is still to build a power plant with the dual purpose of producing both plutonium for military purposes and power for industrial purposes, an interesting financing approach might be worked out. This approach would be consistent with the interests both of the Government and private industry. In this case the utility naturally would own a power plant which would make power for its purposes and also own all of the property related to the power plant. The Government as the expected recipient of plutonium, under the present law, would wish to retain control of the uranium (natural or enriched) and the irradiated fuel for the making of plutonium. Even though the plant ordinarily were operated to make power only, the Government would like to retain the right to direct that the plant change to emphasis on plutonium production upon short notice, and, indeed, in case of dire emergency, have the right to stop furnishing fuel for the plant.

The plant could be built in such a way that in the event the reactor becomes inoperable due to any cause such as troubles related to nuclear power or the necessity for the Government to discontinue the supply of nuclear fuel, the utility could revise it by installing topping turbines and high-pressure boilers to make a conventionally fueled power plant. (This is not an anticipation of failure but merely a method of arriving at the amount of investment a utility could afford to make in a nuclear power plant.) With this in mind, a possible formula for financing might be summarized as follows:

1. The investment in the reactor would be entirely a government investment and financed on the usual government terms.
2. Estimate the capacity of boiler and topping turbine needed to convert to a modern high-pressure coal-fired plant.
3. Estimate the cost of revision including shutdown cost.
4. Add the capacity of the topping unit to the original capacity and multiply the total by an estimated cost per kilowatt of a conventional plant of the same total capacity (say $200) to obtain the value of the revised plant.
5. Subtract the cost of revision (item 3) from the value of the revised plant (item 4) to determine the portion of original utility plant of permanent value to be financed by regular utility financing.
6. The balance of the regular utility plant investment might be financed through government funds in such a way that the utility would be subject to the usual taxes and interest on this part of its investment but the utility obligation with respect to the unamortized portion of such funds would be cancelled in the event that the reactor becomes inoperable.
7. The utility would transmit to the Government each year an amount of money, equal to the value which the power from the reactor plant would have, if generated by a comparable steam plant in the area, minus the utility's actual investment and operating costs incurred.

In the event that the law should be changed in such a way that the utility might become entitled to own the reactor and the fissionable material, the utility could purchase the interest of the Government and operate the plant thereafter in the same way as any other normal utility facility.

The newspapers have reported a Navy proposal to build a land prototype of a reactor to power an aircraft carrier. They have also reported that this might be cancelled or postponed as an economy measure. Let us suppose that a utility were to attempt to build such a prototype but with electric generators to connect to its own system. This project could demonstrate a design for Navy purposes and remain, after completion of any tests and revisions, as a suitable power plant for civilian use. How could this be handled?

Under these circumstances, the private utility might agree to construct a reactor power plant of a size suitable to determine the practicability desired by the Navy. The plant could be tested with output as needed for ship use and then turned over to the utility to operate on a schedule which would meet its own conditions. Such a plant, being the first of its kind and built to accomplish not only continuous operation but to prove the practicability of a military need, would justify a grant-in-aid of construction, or its equivalent, on the part of the Government. A suitable grant-in-aid could make possible net investment and operating charges low enough to make power costs from such a plant competitive with that generated from coal in some of the higher-cost areas of the country. It well might be assumed that if the first such power plant were completed, operated, and made available

for inspection by manufacturers, utilities, and government agencies, it would provide one sure way to get the know-how required to proceed with future commercially successful projects.

These two illustrations merely serve to indicate that there are possible methods of handling the financing of a nuclear power plant which could make it possible to build such a plant in the near future under present technology.

CONCLUSION

A CONSIDERABLE segment of informed opinion would urge that development should proceed along the present lines of continually considering more economical designs of nuclear reactors to produce electric power until one is developed on paper to compete with coal. There is also strong reason to believe that material progress would be made, ultimately benefiting the country as a whole, as well as the utility industry and its customers, by building a full-scale nuclear power plant promptly, using present techniques. Such a plant should be a valuable military asset because it would be in a position to manufacture weapons-grade plutonium continuously if necessary. If plutonium is not necessary during peace time, the plant could operate to produce electric power on a basis such that it is instantly convertible to plutonium production without the necessity for "taking it out of mothballs." This arrangement should make the plant a dispersed source of plutonium to be evaluated against present sources.

Construction of a practical power plant would solve many of the full-scale engineering problems which cannot be simulated in the AEC laboratories. It should serve as a proving ground for future plants of improved designs and assured continuity of service.

Engineering has advanced far enough to proceed with the design and construction of a nuclear power plant. Let us hope that the economic, social, and financial problems can be solved promptly enough to maintain the country's leading position in this important new field.

The Hissing Arc and Radio-Frequency Self-Generated Oscillations in the D-C Carbon Arc

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The radio-frequency oscillations found to be generated by the carbon arc were studied together with the hissing arc and a possible explanation of the latter is presented

THE EXPERIMENTAL apparatus included a General Electric type *WFB* automatic welding head which was used to maintain constant arc voltage and hence arc length for a given current. A block diagram of the automatic feed equipment is shown in Figure 1.

Power was supplied to the arc from a bank of Exide storage batteries capable of supplying 150 amperes at 100 volts for 8 hours. Average values of arc voltage and current were recorded on Esterline Angus recording meters.

The radio-frequency energy produced by the arc was detected by means of conventional superheterodyne radio receivers placed about 10 feet from the arc.

The studies reported here were made with solid projector-type carbons with anode and cathode of the same size and with their axes in line. The sizes of electrodes used were 1/4, 3/8, and 1/2 inch in diameter.

EXPERIMENTAL OBSERVATIONS

Carbon Arc in Air. At low currents, below about 15 amperes for 3/8-inch electrodes and an arc length of 1/8 inch, the carbon arc is relatively quiet. As the current is increased a point is reached at which the arc begins to hiss and the arc voltage drops abruptly about 10 volts. Figure 2, which is the voltage–current characteristic of the carbon arc in air, shows this abrupt drop in voltage.

Several other phenomena occur simultaneously with the beginning of the hissing. The anode spot appears more contracted and begins to move in a rapid random manner, as contrasted with the uniform circular motion of the spot in the case of the quiet arc. At the instant that hissing starts the anode crater becomes less bright, as if it had been cooled suddenly. Radio-frequency oscillations are produced by the hissing arc in narrow bands of frequencies at 1, 2, 4, 8, 16, 32, and 64 megacycles per second. The frequencies of these oscillations are independent of arc voltage, arc current, electrode size, or external capacitance or inductance in the arc circuit. They appear to be caused

Part II, presented at the Third Conference on Electric Welding, Detroit, Mich., April 16–18, 1952, of a series of two articles on self-generated oscillations in the d-c carbon arc recommended for publication by the AIEE Committee on Electric Welding. Part I, "Low-Frequency Self-Generated Oscillations in the D-C Carbon Arc," appeared in *Electrical Engineering*, volume 72, July 1953, pages 612–16.

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The authors wish to thank Dr. W. B. Kouwenhoven, dean of the School of Engineering, Johns Hopkins University, for his many suggestions and encouragement during this research.

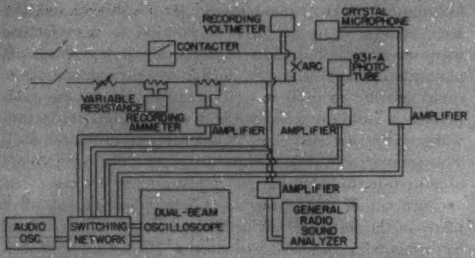

Figure 1. Diagram of apparatus for study of oscillations

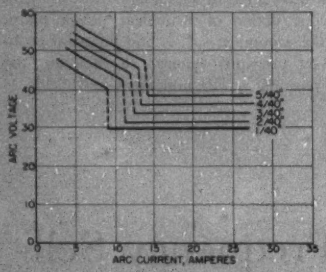

Figure 2. Voltage-current characteristics of the carbon arc in air, 3/8-inch electrodes

by plasma ion oscillations. Radio-frequency oscillations also occur with metallic electrodes such as iron, copper, aluminum, and tungsten, but there is no abrupt drop in voltage when hissing starts.

When the carbon arc begins to hiss, the abrupt drop in voltage is instantaneous and its magnitude is independent of the size of the electrodes or the arc length. The current at which hissing starts is dependent upon the arc length and the anode diameter. Figure 3 shows that the current at which hissing begins increases with increased arc length and increased electrode diameter. The increase in the value of the current is linear with respect to the area of the anode crater, as shown in Figure 4.

Carbon Arc in Other Gases. Voltage-current characteristics of the carbon arc in argon and helium at atmospheric pressure showed no abrupt drop in arc voltage when the arc current was increased to as much as 100 amperes.

When the arc was burned in oxygen or nitrogen, an abrupt drop of 6 volts occurred when the arc began to hiss. Aryton reports an abrupt drop of about 6 volts in hydrogen.[1]

There was no abrupt drop in arc voltage when the carbon arc was burned in carbon dioxide, although hissing and radio-frequency oscillations were produced.

EXPLANATION OF POTENTIAL DROPS IN AIR, NITROGEN, AND OXYGEN

The values of the sudden drop in voltage of the carbon arc that occurs in air, nitrogen, and oxygen have been determined as 10 volts in air and 6 volts in nitrogen or oxygen. Ayrton reported that in hydrogen the arc hissed with an abrupt drop in voltage of about 6 volts. Since this drop in voltage is intimately connected with the beginning of hissing, its magnitude for the different gases should help to explain the hissing process. In order to see the connection between hissing and the voltage drop, the values of the anode and cathode drop of the carbon arc in air must be considered.

The most careful measurements of the anode and cathode drops of the low-current carbon arc in air at atmospheric pressure probably have been those made by Mason.[3] He determined the potential distribution along the arc by the probe method and studied extensively the errors introduced by the probe. The arc studied by Mason was between solid carbons with an arc length of 0.89 centimeter (0.35 inch) and currents between 3 and 12 amperes. After correcting for the probe errors, Mason estimates the anode drop as 20 volts and the cathode drop as 10 volts. With the value of arc length and the low currents used by Mason, the arc he studied was certainly of the type that has been described here as a quiet arc. Finkelnburg estimates the cathode drop of the high-current carbon arc as about 10 volts in the Field Information Agency Technical Report.[8] The earlier accepted value of the cathode drop was somewhat higher, about 14 to 15 volts. The anode drop of the high-current arc has been estimated as about 10 volts by Finkelnburg.

Figure 5 shows the variation of the arc voltage with arc length for several values of arc current, including currents for which the arc is "quiet" and those for which the arc is hissing. The constant slope of the lines indicates that the potential gradient is a constant independent of current in the range of currents considered. The essential fact to be gained from this curve is that the potential gradient in the

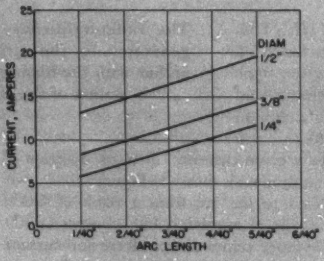

Figure 3. Variation of current at which carbon arc begins to hiss with arc length for different electrode sizes

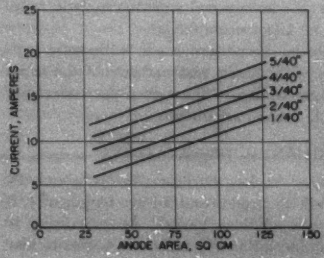

Figure 4. Variation of current at which hissing begins with anode area for carbon arc with various arc lengths

column does not change when the arc begins to hiss. Furthermore, the intercept on the ordinate gives the approximate sum of the anode and cathode potential drops. It can be seen that, as the current increases from 5 to 10 amperes, the sum of the drops decreases from 40 to 30 volts. The cathode drop of the low-current carbon arc has been reported by Mason as 10 volts, and the cathode drop of the high-current carbon arc has been reported by Finkelnburg as 10 volts, independent of current.

Having thus established that, in all probability, both the potential gradient of the column and the cathode drop of the arc are constant for the hissing arc and the quiet arc, the only conclusion is that the negative slope of the voltage–current curve before hissing and the abrupt drop in voltage that takes place at the instant the arc begins to hiss occur in the anode-drop region. From Figure 5 for a current of about 10 amperes, the sum of the anode and cathode drops is 30 volts. Subtracting the constant cathode drop gives an anode drop of 20.5 volts. Thus, at the instant that the arc is on the verge of hissing, the anode drop is about 20.5 volts. The anode drop represents the energy required to produce positive carbon ions which are required to neutralize the electrons in the column to provide a path of high conductivity for the arc current. The fact that the anode drop is associated with the production of positive ions can be seen from the results of the carbons with cores of alkali metals. When an alkali metal, with its low ionization potential of 4 to 5 volts, is present at the anode, the arc voltage drops to about 15 volts. This indicates that the anode drop is approximately equal to the lowest ionization potential of the anode material. When the arc begins to hiss, the anode voltage drops about 10 volts, and spectrographic study shows the appearance of molecular spectra of the nitric oxide molecule. Thus, clearly the anode drop of the hissing arc is equal to the ionization potential of nitric oxide. The darkening of the anode surface observed at the instant of hissing is explained by the fact that less energy is being supplied to the anode; in fact, only about half as much energy is supplied at the instant hissing starts.

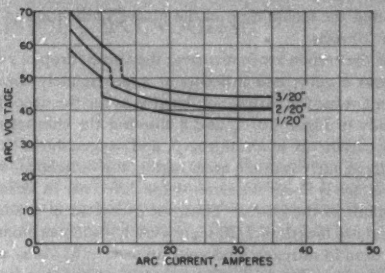

Figure 7. Voltage–current characteristics of carbon arc in nitrogen, 1/4-inch electrodes for various values of arc length

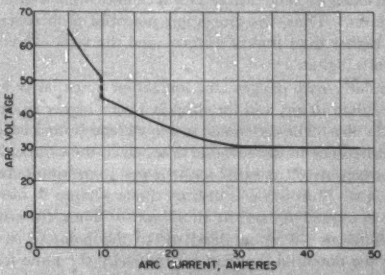

Figure 8. Voltage–current characteristics of carbon arc in 20-per-cent-oxygen–80-per-cent helium mixture, 1/4-inch electrodes, 2/20-inch arc length

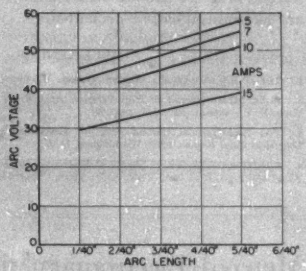

Figure 5. Voltage–arc length characteristics of carbon arc in in air, 3/8-inch-diameter electrodes

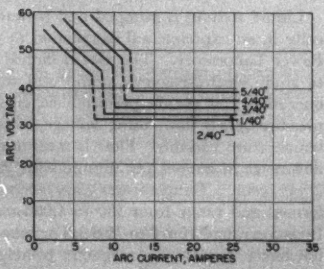

Figure 6. Voltage–current characteristics of carbon in air, 1/4-inch electrodes

Loeb[4] has calculated the anode drop from consideration of the radiation loss. The anode gains energy from the product of the current density by the anode drop and the heat of condensation of the electrons. The anode loses energy essentially by radiation. The energy loss is $g\sigma T^4 = j - (V_{an} + \phi_e)$, neglecting evaporation and conduction as small compared with radiation. Thus, $V_{an} = [g\sigma T^4/j] - \phi_e$. With $g \approx 0.75$, ϕ_e about four for carbon, T_{an} equal to 4,100 degrees Kelvin, and j equal to 80 amperes per square centimeter, V_{an} is 10.5 volts. The arc will be a hissing arc, since the carbon arc begins to hiss at a current of about 40 amperes per square centimeter, as reported by Finkelnburg. This calculated value of the anode drop is, therefore, in close agreement with the observed value of 9.5 to 10 volts. Loeb considers the value of 10.5 volts too low because he feels that the anode drop should be about 20 volts, evidently based on Mason's finding. The correlation of the observed and calculated values of anode drop thus appears to indi-

cate that the anode drop of the hissing carbon arc in air is about 10 volts.

For the carbon arc in nitrogen, the abrupt drop in voltage is about 6 volts, and it occurs at approximately the same current value for various arc lengths as for the drop in air. A study of Figures 6, 7, and 8 showing the characteristics of the carbon arc in air, nitrogen, and oxygen shows that for any given current in the quiet region, the difference in total arc voltage is about the same as the difference in ionization potentials of the gases. Thus, for a current of 5 amperes and an arc length of 2/20 inch with 1/4-inch carbons, the total drop in nitrogen is 66 volts, in oxygen 63 volts, and in air 60 volts. The ionization potential of nitrogen is 15.57 volts, of oxygen 12.5 volts, and of nitric oxide, in the case of the arc in air, 9.5 volts. The effective ionization potential of air probably will be that of the nitric oxide molecule which exists in some degree at the cathode even before hissing starts. Thus, the ionization potential of nitrogen is 3 volts higher than that of oxygen, and the total arc voltage is 3 volts higher.

Similarly with oxygen, the ionization potential is 3 volts higher than in air, and the drop is 3 volts higher in oxygen than in air. The difference in arc voltage is then reflected as a difference in the cathode drop, since the cathode drop can be considered as equal to the lowest ionization potential of the gas. Just prior to hissing, the total drop in nitrogen is 53, in oxygen 50, and in air 47 volts. Thus, the same 3-volt difference is maintained up to the point of hissing. Since the potential gradient is practically the same for the three gases, the anode drop must be the same for the three gases just prior to hissing, namely, 20 volts.

The ionization potential of the cyanogen molecule is 14 volts. Hence, the 6-volt drop that occurs in the nitrogen arc is the difference between the 20-volt drop prior to hissing and the 14-volt drop after hissing. In the case of the carbon arc in oxygen, carbon monoxide and carbon dioxide will be formed, with carbon dioxide more likely to be formed if there is sufficient oxygen. The ionization potential of carbon monoxide is 14.1 and of carbon dioxide 14 volts. Thus, the 6-volt drop in the case of oxygen is the difference between 20 and 14 volts. In hydrogen, methane will be formed with an ionization potential of 14.5 volts. The drop should then be 5.5 volts, compared with an average of 6 reported by Ayrton.

The abrupt drop of the voltage when the carbon arc begins to hiss thus is explained as a change in mechanism of supplying the positive ions in the anode region. The arc in carbon dioxide should show no such abrupt drop, since the ionization potential of the carbon dioxide is already the lowest that can exist. This was found to be the case from the characteristics of the arc in carbon dioxide. The arc hisses and produces radio-frequency oscillations, but there is no abrupt drop in voltage when the arc goes from the quiet to the hissing state. Likewise, in the arc between metal electrodes in air, nitrogen, or oxygen there is no abrupt drop in voltage when hissing starts, since the ionization potential of the metal anode is already lower than that of the products. For example, the ionization potential of tungsten is 8.1 volts; of aluminum 5.96; of copper 7.68; and of iron 7.83. Experimentally this was found to be the case with the tungsten arc in oxygen. The arc hisses, but again there is no abrupt drop in voltage.

CONCLUSIONS

THE ABRUPT DROP in voltage that occurs when the carbon arc begins to hiss in air, nitrogen, oxygen, or hydrogen thus appears to be a result of the change of mechanism for supplying positive ions at the anode. There is no abrupt drop in inert gases or in gases such as carbon dioxide, because there are no products formed with lower ionization potentials than those that already exist in the arc. Similarly, with metallic electrodes, there is no drop in voltage because the ionization potential of the metal is lower than that of the product formed.

Further studies along these lines to verify the results described here are needed before a more complete idea of the arc mechanism can be presented.

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3. The High-Current Carbon Arc, **W. Finkelnburg.** Field Information Agency Technical Final Report *1052*, Washington, D. C.
4. Fundamental Process of Electrical Discharges in Gases (book), **L. B. Loeb.** John Wiley and Sons, Inc., New York, N. Y., 1939. Page 615.

Liquid Sodium Pumped and Metered Electromagnetically

Liquid sodium is pumped and metered electromagnetically in an experimental installation at the Knolls Atomic Power Laboratory. The closed circuit loop was devised to study electromagnetic pump and magnetic flowmeter operation and obtain performance curves by computing pressure versus flow, using voltage, pressure, and sodium temperature variants. Flow is measured by the magnetic flowmeter in gallons per minute with an accuracy within 2 per cent. Temperatures vary according to tests performed and range from 580 to 1,000 degrees Fahrenheit. Pressures range from 0 to 75 delta pressure. The pump and flowmeter operate on magnetic principles.

Approximation of Transient Response

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ALTHOUGH FEEDBACK CONTROL design requirements usually specify the output time response to some standard form of input, the design process commonly is performed on a frequency response basis. The existing wealth of knowledge and experience in steady-state a-c circuit theory and in feedback amplifier performance justifies this design procedure. Under these conditions the need to transform from the frequency to the time domain is great. Exact mathematical methods of performing the desired transformation for linear systems exist but unfortunately do not lead to closed form results except in very special cases. Since even completely random inputs may be considered as composed of successions of impulses, knowledge of impulse response leads easily to the response for any specified input.

An approximation for the time response of a linear system to a unit impulse input when the open-loop frequency response is known can be developed from the inverse Laplace or Fourier transform. Loci of constant imaginary components of the closed-loop frequency response leading to a plot of the imaginary component, I, against angular frequency, ω, can be superimposed on the Nyquist or Bode plot of the open-loop response. I is assumed to be zero above ω_0, a cutoff frequency empirically obtained from the investigation of four direct feedback systems having widely different open-loop characteristics. Excellent results are obtained for the four systems when ω_0 is taken equal to 1.3 times the frequency, $\omega_{0.1}$, at which the imaginary component is equal to -0.1 and decreasing in absolute value.

I is then expanded as a Fourier sine series in the interval $0 \leq \omega \leq \omega_0$ as

$$I(\omega) = \sum_{n=1}^{\infty} a_n \sin (n\pi\omega/\omega_0) \qquad (1)$$

When equation 1 is substituted in the inverse transform formula,

$$c(t) = -(2/\pi)\int_0^{\infty} I(\omega) \sin \omega t \, d\omega \qquad (2)$$

the resulting integration gives

$$c(t) = 2\omega_0 \sin \omega_0 t \sum_{n=1}^{\infty} [n(-1)^n a_n]/[n^2\pi^2 - \omega_0^2 t^2] \qquad (3)$$

In addition to the empirically determined ω_0, assumptions are made that the imaginary component decreases linearly in the range where its absolute value is less than one tenth and hence difficult to determine from the loci plots, that 18-point graphical integration gives sufficiently accurate values of the Fourier coefficients, and that contributions to the time response of terms higher than the fourth in equation 3 are negligible. The figure of 1.3 in the determination of ω_0 represents a lower limit on this constant set so that the part of the imaginary component excluded from consideration does not introduce excessive error into the results. The upper limit on possible values of ω_0 is dependent on the validity of the latter three assumptions and varies widely in the systems studied. Error is arbitrarily measured by taking the square root of the average of the squares of the differences between the predicted and actual responses at 20 points equally spaced over the first positive alternation of $c(t)$. To establish a percentage reference, the same error was computed assuming that a difference equal to one per cent of the actual $c(t)$ existed at each of the 20 times. The ratio of 1.3 gave errors of less than five per cent on this basis for each of the four systems.

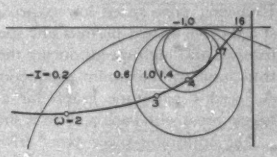

Figure 1. Loci of constant I superimposed on the Nyquist plot of $C/E = [5(1+j\omega)^3]/[(j\omega)^3(1+j0.05\omega)^3]$

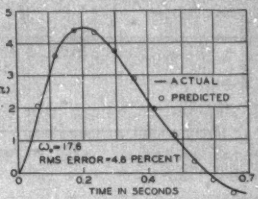

Figure 2. Actual and predicted impulse responses ($\omega_0/\omega_{0.1} = 1.29$) for the system of Figure 1

This method and the foregoing assumptions are valid for times less than $4\pi/\omega_0$, as shown by Figure 2 for a specific example, and the labor of computation is materially less than that required by other methods giving results of comparative accuracy. The validity of the method for higher-ordered systems and for those not having direct feedback has not been investigated. The same procedure can, of course, be applied wherever an approximation of the inverse Laplace transform is desired, provided the behavior of the transform is known on the real frequency axis.

Digest of paper 53-248, "Approximation of Transient Response From Frequency Response Data," recommended by the AIEE Committee on Feedback Control System, and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer General Meeting, Atlantic City, N. J., June 15-19, 1953. Scheduled for publication in AIEE *Transactions*, volume 72, 1953.

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This paper is a revision of a doctoral thesis done by C. H. Dawson at Iowa State College.

Adjustable-Speed D-C Drives for Deep-Draw Presses

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STREAMLINED AUTOMOBILE designs require deep drawing of component body parts in modern presses where flywheel, clutch, and simple crank action are replaced with toggle action and direct-connected drive motors.

If metal is drawn too rapidly it tears, resulting in scrap. Reducing press speed lowers production. An adjustable-speed-drive system permits low speeds during the drawing interval and high speeds during the remainder of the cycle, thus insuring maximum production and minimum scrap. A speed versus time graph for a 1,000-ton triple-action toggle press with such a cycle is shown in Figure 1.

The adjustable-speed press drive used is an adjustable-voltage d-c direct-drive system. Figure 1 shows that the 500-horsepower d-c driving motor must be accelerated from rest to high speed in approximately 1/2 second.

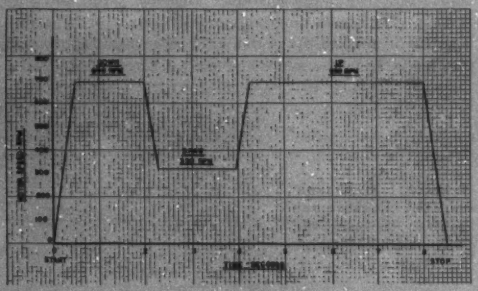

Figure 1. Motor speed versus time for one press cycle

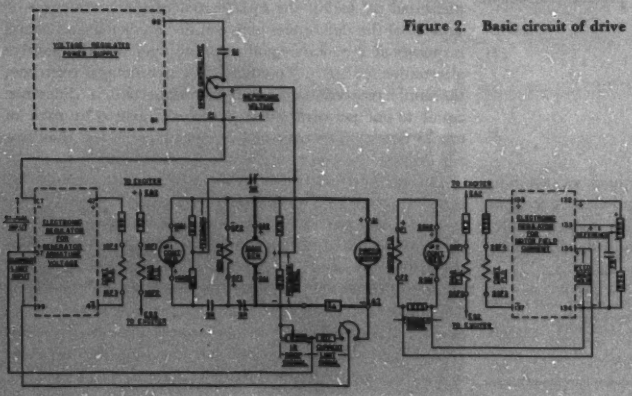

Figure 2. Basic circuit of drive

D-c motors and generators of this size have field time constants of 2 to 3 seconds, which means that any field current change will require an elapsed time of 6 to 9 seconds to reach its final value. In order to overcome this problem the drive employs field forcing which consists essentially of applying an overvoltage to the field during the time a field current change is required and then quickly removing the overvoltage when the desired value of field current is reached.

Figure 2 is a diagram of the circuit of the drive. The main generator is excited by the number *1* control generator which in turn is excited by an electronic regulator. A reference voltage for setting the drive speed is obtained from a regulated direct-voltage supply. This reference is balanced against a feedback voltage from the generator armature thus regulating generator voltage.

A voltage drop across a motor armature resistor is used for both a motor current-resistance drop compensation signal and a current-limit signal. By current limiting during acceleration and deceleration the motor is made to accelerate and stop in the minimum time possible without exceeding the commutating ability of the motor or main generator.

The motor field is weakened over part of the speed range. Field forcing is employed through control generator number *2* which is excited from an electronic regulator which regulates motor field current.

In order to use field forcing, the control must respond practically instantaneously to remove field overvoltage. For this reason electronic regulators were selected. Rapid response is also required in the current-limit circuit to limit the initial accelerating current peaks. When stopped, the main generator is suicided through relay *SR*, thus eliminating the main line contactor. Five standard small control relays and a cam switch are required to start the drive, run it through its cycle, and stop.

Five drives of the type described are in operation. Oscillographs show that the drive motor is accelerated from rest to 690 rpm in about three revolutions of the motor shaft. Production results obtained have been satisfactory, with records exceeding anticipated figures.

Digest of paper 53-4, "Adjustable-Speed D-C Drives for Deep-Draw Presses," recommended by the AIEE Committee on Industrial Control and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 19–23, 1953. Scheduled for publication in AIEE *Transactions*, volume 72, 1953.

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Reactance Influence on 6-Phase Rectifiers

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CONVENTIONAL METHODS OF calculating rectifier voltage regulation are valid only if the angle of overlap is less than 360 degrees divided by the number of phases. With larger overlap angles, any a-c reactance common to two or more simple rectifiers introduces an angle of inherent delay, even though the rectifiers are operated without phase control. This inherent delay reduces the direct voltage and, therefore, increases the voltage regulation.

Included is a curve for estimating voltage regulation of 6-phase double-way and double-Y rectifiers. Defining $I_c X_c/E$, as the reactance factor based on commutated direct current, the ratio of direct voltage to no-load direct voltage (E_d/E_{do}) is plotted against reactance factors in Figure 1. The curve applies to both double-way and double-Y circuits provided that, in the case of the double-Y circuit, leakage reactance between secondaries is negligible. Based on the load circuit being predominantly inductive, there are three modes of operation as load current is increased from zero to short-circuit value. In the first mode of operation the commutating angle (u) increases from zero to 60 degrees. During the second mode the commutating angle is fixed at 60 degrees, but the start of commutation is delayed by an inherent delay angle (α) which varies from zero to 30 degrees as load current is increased. The inherent delay angle does not increase during the third mode as the commutating angle increases to 120 degrees at short circuit. Commutating angle and inherent delay angle are plotted against reactance factors in Figure 2.

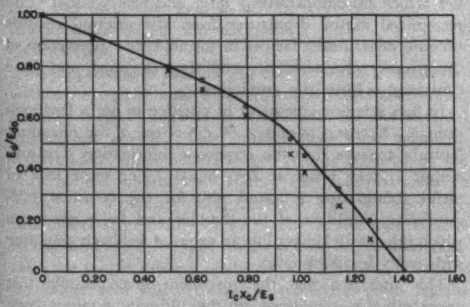

Figure 1. Voltage regulation curve for 6-phase rectifier showing laboratory data

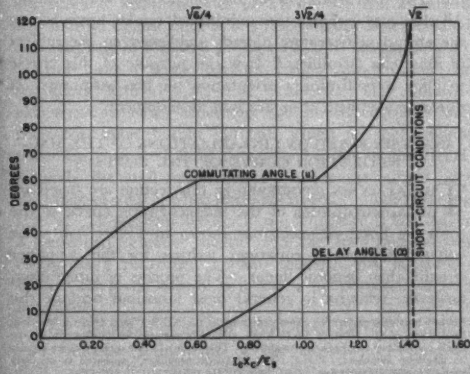

Figure 2. Commutating angle and forced delay angle in 6-phase bridge rectifier

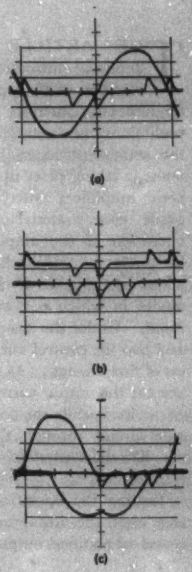

Figure 3 (right). Laboratory waveshapes for $\alpha = 30$ degrees, $u = 90$ degrees

(*a*) *Line-to-line voltage*
(*b*) *Line-to-line and anode-to-cathode voltages*
(*c*) *Anode-to-cathode voltage and anode current*

Calculated values of E_d/E_{do} were substantiated by laboratory data taken from a model rectifier on the analogue computer. In Figure 1 the laboratory points are indicated by crosses and laboratory data corrected for resistance drop in the circuit are indicated by circles. Oscillograms taken on the analogue computer during the third mode of operation are shown in Figure 3. Figure 3*a* shows the oscilloscope calibration, line-to-line voltage at no load, and a line-to-line voltage for 30 degrees inherent delay with approximately 90 degrees overlap. The oscilloscope was adjusted to make one time division equal to approximately 36 degrees and this calibration was maintained for all pictures.

Digest of paper 53-54, "Influence of A-C Reactance on Voltage Regulation of 6-Phase Rectifiers," recommended by the AIEE Committee on Electronic Power Converters and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 19-23, 1953. Scheduled for publication in AIEE *Transactions*, volume 72, 1953.

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Methods of Magnetic Amplifier Analysis

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A brief survey is presented to provide orientation in the abundant magnetic amplifier literature. Although lacunae still exist between the results of analyses and the requirements of designers with exacting performance specifications, extensive research is being continued as seen by the most recent literature.

THE ARTICLE BY Johnson[1] introduced a number of concepts of fundamental interest for a preliminary understanding of the somewhat unusual phenomena taking place in magnetic amplifiers with high-grade core materials. The operation of the amplifier* appears to be characterized by modes in which the voltage of the a-c source is balanced by the rates of change of both core fluxes, and by modes in which one or the other of the cores is saturated. Under the assumptions made the output current and also the control current are both zero during the process of flux change. As soon as one core saturates, "firing" occurs; the output current is limited only by the resistance of the load while the control circuit, still coupled with the gate circuit through that core which is not saturated, acts like the secondary circuit of a conventional current transformer.

Tracing the operation through a complete cycle it is seen that the instantaneous values of control current i_c and of rectified output current i_L have the same waveform and are in the inverse ratio of the number of turns; hence the d-c component of control current, I_c, is related to the rectified average value of load current I_L by the d-c transformer law $N_c I_c = N_g I_L$. As a result the amplifier output is controlled by the voltage of the signal source as it is this source which supplies I_c in the control circuit. These results check well with the experimentation but for minor deviations which should be expected in view of the extremely simplified representation used for the magnetic characteristic.

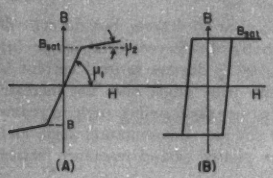

Figure 1. Linearizations of magnetic characteristics

The addition of external feedback windings N_f modifies the previous reasoning as the total d-c "control" ampere turns acting on each core result now from ampere turns of "signal" proper, $N_s I_s$, and from ampere turns of feedback. According to the original treatment the balance of ampere turns per core is modified into $N_f I_L + N_s I_s = N_g I_L$. As N_f is increased and approaches N_g, the signal requirements for a given output decrease and higher gains are obtained. At the same rate, however, the simplified analysis becomes less adequate to supply accurate information on the signal requirements, because $N_s I_s$ results as the difference between two quantities which are comparatively large and nearly equal. The recognized minor departures from the original analysis become determining factors in the analytical prediction of the transfer characteristic, and thus of gains and time constants, of high-gain amplifiers.

In fact it is not infrequent in practice to use a feedback ratio N_f/N_g equal to unity. A direct use of the foregoing formula conveys then the erroneous information that any output I_L may result at zero signal. The same lack of useful information is found also for the common self-saturating amplifiers of the doubler and full-wave types which inherently behave like an external feedback amplifier with unity feedback ratio.

This indicates that the treatment given should not necessarily be considered as the ultimate analysis but, rather, as a starting point from which more refined methods are developed. Also other types of reasoning are used profitably, with different approaches and even with different interpretations of the phenomena under study. All this may perplex the uninitiated reader approaching the abundant literature already published on the subject of magnetic amplifiers.[2] It is the purpose of this article to offer a preliminary orientation on the basic ways of thinking used and their gradual development.

ANALYSES BASED ON LINEARIZATIONS OF THE MAGNETIZATION CURVE OF THE CORES[3-6]

THE ANALYSES CONSIDERED in this section are based on an approximation of the magnetization curve of the cores by linear segments, as shown in Figure 1*A*. The voltage differential equations written for the amplifier circuits then become linear. The process of integration, however, remains in general most laborious because the

* A more complete critical comparison of basic methods of analysis of magnetic amplifiers is found in the Carnegie Institute of Technology Series of Technical Reports on Magnetic Amplifiers, Report number 11 by L. A. Finzi and G. F. Pittman, Jr., under United States Naval Research Contracts *N7 ONR 30305* and *30308*—Projects numbers *075-272* and *275*. An abridged report appears in the National Electronics Conference *Proceedings*, volume 8, 1952.

Revised text of a conference paper presented at the AIEE Winter General Meeting, New York, N. Y., January 19-23, 1953, and recommended for publication by the AIEE Committee on Magnetic Amplifiers. This is Part II of a series of three articles on magnetic amplifiers; Part I, "The Magnetic Amplifier," appeared in the July issue of *Electrical Engineering*.

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linearized inductances of the windings change their values abruptly during the cycle whenever the permeability $\mu = dB/dH$ of either of the cores changes from the value μ_1 to the value μ_2 or vice versa. Boundaries must be matched in the solution at these times, which generally are not known in advance, with not too straightforward mathematical manipulations.

The problem simplifies considerably if particularly simple types of impedances are considered in gate and control circuits and if additional simplifying approximations are used for values of μ_1 and/or μ_2. The treatment given in the introduction in fact belongs to this general group of analyses, with the assumptions of zero control circuit impedance, of purely resistive load, and also of $\mu_1 = \infty$ and $\mu_2 = 0$ in the linearization of the magnetic characteristic.

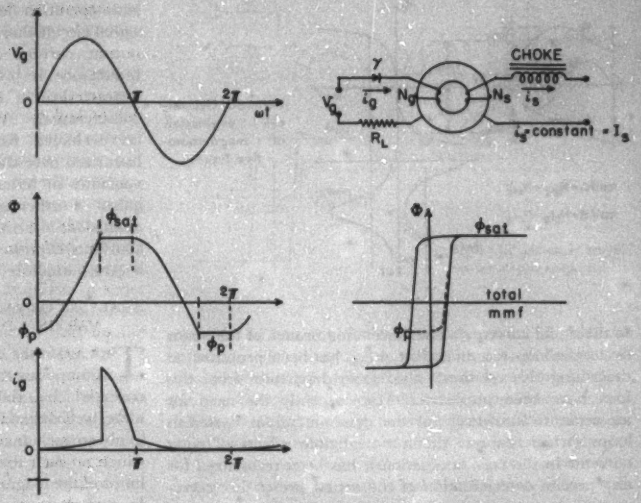

Figure 2. The self-saturated single-core component

An approximate solution still can be obtained, however, without excessive analytical difficulty if the assumption μ_1 very large but finite is substituted for the original assumption $\mu_1 = \infty$. This implies that some magnetomotive force, small but no longer zero, is required by the core in the unsaturated state. The analysis proceeds broadly in a manner quite similar to the one described,[1] but differs significantly in its results as the total control magnetomotive force that results is now larger than $N_c I_c$. Also the output current of the amplifier at zero control is no longer zero and accordingly account is given for the shift of feedback transfer characteristics in the negative signal direction which is recognized experimentally. (This shift is shown in Figures 9*B* and 10 of the introductory article by means of feedback constructions applied to the experimental characteristics of Figure 9*A* and Figure 6 which differ significantly in this respect from the calculated characteristic of Figure 5*A*. See *EE, Jul '53, pp 583-8.*)

Thus more realistic over-all results are obtained for amplifiers with 100-per-cent feedback. This analysis also accounts more accurately for the influence of load resistance upon output current, which in the original treatment appeared to be determined solely by the signal. Actually the load resistance does affect the output over the range of control when feedback is used. In the limiting case of 100-per-cent feedback the amplifier is no longer a controlled "current source" into the load but behaves rather as a controlled voltage source; that is, output current for given control is inversely proportional to load resistance.

This modified treatment constitutes hereby a logical and welcome refinement of the introductory analysis. Still a serious limitation inherent to any such single valued representation of the magnetic characteristic is seen in the fact that hysteresis phenomena, which are really of foremost significance in the performance of high-feedback amplifiers with grain-oriented nickel-alloy cores, are not properly accounted for. In fact the finite value of μ_1 to be used in the analysis just mentioned is not obtained from magnetic measurements on the core; rather the suggestion is made that it be evaluated backwards from experimental transfer characteristics measured on the magnetic amplifier using these cores.

The use of a double-valued linearization of the magnetic characteristic, for example as shown in Figure 1*B*, may suggest itself at this point to account more directly for hysteresis phenomena; unfortunately a number of ambiguities seem to arise in the extension of the previous methods to any such double-valued linearization.

THE SELF-SATURATED SINGLE CORE AS A COMPONENT OF DOUBLER AND FULL-WAVE AMPLIFIERS[8-10]

In this type of approach a single core is considered at first, as shown in Figure 2, and it is assumed that the signal winding is fed by a constant current source.

Since the current i_g is zero at the beginning of the positive half-cycle of gate voltage, the ampere turns of the signal current I_s establish the initial flux level in the core. Then, in the first portion of the positive half-cycle the gate voltage is absorbed by the change of flux until saturation is reached; (that is, until the core absorbs a volt-time area corresponding to the difference between the saturation flux ϕ_{sat} and the initial flux ϕ_p preset by I_s). At this time "firing" occurs and the gate voltage appears across the load until it goes negative, or nearly so. During the subsequent negative half-cycle i_g at some time becomes zero; the core flux is reset again to the level established by I_s and the process repeats.

In order to predict the transfer characteristic of this circuit one must know how the preset flux level is related

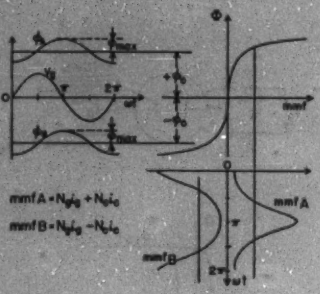

Figure 3. Graphical evaluation of magnetomotive forces

to the signal current. The descending branch of the major hysteresis loop terminated at $\pm\phi_{sat}$ has been proposed as describing this relation; also, some departures from this idea have been suggested. More recently the need for an accurate knowledge of the dynamic minor hysteresis loops (which express the not negligible effects of eddy currents in the core laminations), has been recognized for any precise determination of the actual preset flux corresponding to a given signal current.

This type of thinking is used as a preliminary step in the study of conventional, 2-core self-saturating amplifiers, doubler and full-wave, by considering that such amplifiers consist of two such single-core components feeding a common load. It should be pointed out, however, that the whole reasoning is based on the assumption of a constant signal current which implies a very high signal circuit impedance. Although fundamental frequency voltages cancel in the signal circuits of 2-core amplifiers, even harmonic voltages are induced and cause harmonic currents to flow to a degree depending on the actual signal circuit impedance. The preceding analyses on the other hand were based on the opposite assumption of very low signal-circuit impedance. Truly, in conventional 2-core amplifiers neither assumption is quite met, and, in all cases, the signal-circuit impedance influences the transfer characteristic in a manner not directly predictable from any one of the preceding simplified analyses. Further research still is needed along this line.

Leakage and capacitance effects of feedback rectifiers also affect the transfer characteristic, but so far only some of these effects have been accounted for analytically in an approximate way.

Finally, extensions of all analyses described are needed to cover situations of more general loads, that is, not purely resistive; some of these needs are being met in the most recent literature.

The transient performance of the various magnetic amplifier circuits is analyzed by determining the variation of average core flux following a step change in signal voltage and using steady-state expressions to relate rectified average output current to average core flux throughout the transient. For this an "effective" differential inductance of the signal circuit is defined as the ratio of the change in average signal circuit flux linkages to the corresponding change in average signal current. The steady-state operation described indicates that changes in average signal-circuit flux linkages and changes in rectified average output current are proportional; hence signal-circuit inductance is proportional to the slope of the transfer characteristic of the amplifier at the operating point under consideration. An approximate time constant thus can be evaluated from steady-state transfer characteristics linearized over the range of interest and be expressed conveniently in terms of suitably defined current or voltage gains. Furthermore, an over-all figure of merit may be defined as the ratio of incremental power gains to time constants expressed in cycles of the supply frequency for a given amplifier.

ANALYSES OF AMPLIFIERS WITH CORE MATERIALS OF VARYING DIFFERENTIAL PERMEABILITY[11-13]

THE ANALYSES considered before all have been based on assumptions tailored to fit grain-oriented nickel-alloy cores which exhibit sharp and complete saturation at some well-defined flux level. These assumptions hardly apply to such materials as transformer steel or ferrites for which no such sharp transition occurs within the practical limits of the magnetomotive forces allowed by the windings. In such instances a different approach is chosen with a method familiar to the transformer designer who wishes to evaluate instantaneous values of power transformer exciting currents. For instance in the case of the simple magnetic amplifier without feedback (see reference 1, Figure 1) it is assumed now that the fluxes vary sinusoidally throughout the whole cycle about some average value. That is, with $v_g = V_{gm} \sin wt$, the statement is made $\phi_A = \phi_{max} \sin (wt - \pi/2) + \phi_0$ and $\phi_B = \phi_{max} \sin (wt - \pi/2) - \phi_0$ where ϕ_{max} depends on the voltage and frequency of the a-c source and the level ϕ_0 is in some way controlled by the average control current. (This statement really is justified only if voltage drops in control circuit impedances and also in load impedances are small.) Thus the instantaneous values of magnetomotive forces of either core are evaluated graphically as shown in Figure 3 or else, more conveniently, in closed analytical form using some suitable functional relationship to express the magnetic characteristic of the core as represented by its normal

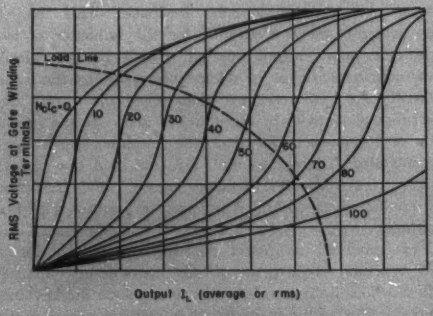

Figure 4. Zero load characteristic curves

magnetization curve. Instantaneous currents in gate and signal circuits are then obtained from magnetomotive forces mmf_A and mmf_B of the two cores.

The results are commonly presented in the form of characteristic curves expressing rectified average or rms output current versus alternating voltage applied to the gate windings for various values of average control current as shown in Figure 4. The results of the above zero load analysis agree rather well with the experimentation. Calculated (or directly measured) zero-load characteristics are utilized in more realistic situations in which loads, resistive or reactive, do exist by simply plotting suitable load lines. In doing this the approximation is accepted that the gate windings of the magnetic amplifier in series with the load may be considered as a linear inductance of a value prescribed by the signal current and by the resulting voltage that is impressed across the windings.

For more accurate evaluations, the alternative remains open to attack the nonlinear problem directly by methods of successive approximation, which, however, are not likely to converge rapidly because of the pronounced nonlinearity involved.

The influence of feedback circuits again is accounted for to a first approximation with the same general techniques described,[1] as the ampere turns of feedback intervene to reduce the signal requirements. Analytical refinements directed toward a more precise evaluation of elusive phenomena influencing the actual operation of feedback circuits are found in the literature.

Here again transient performance is analyzed through the transient in average core flux ϕ_0 as determined from graphical or analytical integration of the nonlinear voltage differential equation of the signal circuit on a cyclic average basis.

SINGLE-CORE AMPLIFIERS FOR RAPID RESPONSE[13]

In the amplifiers considered so far the voltage of the signal source acts to produce a current through the resistances of the signal circuit, the magnitude of this current substantially determining the initial, or the average, flux level and thus the output.

Other types of amplifiers with grain-oriented nickel-alloy cores have been devised in which the signal voltage acts in more direct ways to govern the initial flux level ϕ_p. An example of this way of thinking is shown in the single-core amplifier of Figure 5. Here v_p is the sinusoidal supply voltage and v_s is the signal voltage which, for the sake of simplicity, is assumed to be obtained from a full-wave rectified signal source. Its polarity is always directed against the rectifier σ.

During the positive half-cycle of the supply voltage the operation is the familiar one. The core flux builds up from preset level toward saturation while some negligibly small magnetizing current flows through the rectifier γ; when saturation is reached firing occurs and then the current is limited by the load resistance; as v_p goes to zero the current in the winding decays also to zero leaving the core at the saturated level $+\phi_{sat}$.

In the subsequent half-cycle v_p reverses its polarity and overrules v_s. The rectifier σ becomes conducting and the

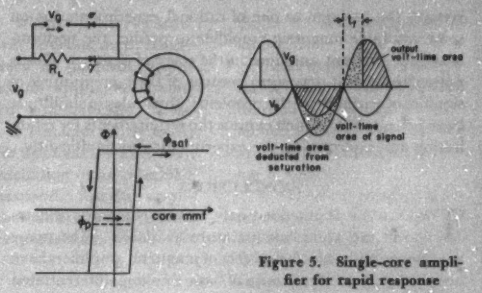

Figure 5. Single-core amplifier for rapid response

core flux is brought down from saturation. Under the opposing action of v_p and v_s a flux level ϕ_p is reached at the end of this half-cycle; this is the flux level from which the next positive half-cycle initiates and proceeds.

The amount by which the core flux has been brought down from saturation is shown by the volt-time area of the spotted crescent in Figure 5. This is the volt-time area which must be reabsorbed by the core in the subsequent positive half-cycle before saturation and firing occurs. Thus the larger the signal, the smaller the spotted crescent, the shorter the time t_f required to reach the firing point, and, finally, the larger the subsequent output. In fact the shaded output volt-time area of the load voltage after firing is equal to the volt-time area of the signal voltage alone in the preceding negative half-cycle.

This is the essential feature of this device. As a corollary it follows that changes of signal voltage introduced, for example, before initiation of a negative half-cycle will have full effect already in the output of the next positive half-cycle.

No need is felt to introduce concepts of magnetomotive forces in the qualitative description of the operation of this device as the attention is focussed rather on a control of flux levels obtained from the volt-time area of the signal voltage. Under the assumption of suitable hysteresis loops for the core there is no substantial analytical difficulty, however, in the evaluating of instantaneous values of magnetomotive forces and thus of magnetizing currents during intervals of flux changes. In fact this determination may be desirable to account for the influence of resistive voltage drops of magnetizing currents which may modify the volt-time areas in question and thus the operation.

OTHER APPROACHES[14–15]

Difficulties of integration of the nonlinear circuit equations describing the system are responsible for the more or less adequate idealizations and simplifications forced into the various analyses. Some of these difficulties are eliminated if capable differential analyzers are available. Also the use of analogue computers has been suggested for the same purpose, for example, by approximating the magnetization curve with suitable electronic circuits.

In the latter line of thought magnetic cores can be used directly as nonlinear elements of the analogue. Really this

reduces the problem to one of rational experimentation on some available magnetic amplifier to predict the performance of a different amplifier in the stage of design. This is not as trivial as it may seem because of the large number of significant variables of the problem; thus rules of similitude have been derived which express the requirements for establishing and interpreting the experimentation significantly.

CONCLUSIONS

THIS SURVEY is intended only as an elementary orientation in the abundant literature available. The many analyses published on the subject of magnetic amplifiers have been reduced to fewer groups of basic thinking differentiated by the type of approach chosen expediently by the various authors in order to surmount in some way the difficulties of nonlinear problems which escape unified general treatments. Within each group a gradual development is noticed; inadequate idealizations are discarded in favor of more accurate procedures and assumptions. Many effects previously neglected are being recognized in their significance and accounted for, and the scope of the problems treated is being broadened. Undeniably many gaps remain to be bridged between the results of the analyses and the requirements of designers dealing with exacting performance specifications. This situation is all but unusual in the history of any field of engineering; in this particular new field it is being faced presently with further extensive research as evidenced by the most recent literature.

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Motor Overload Protection for Domestic Appliances

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THE REQUIREMENTS of Underwriters' Laboratories, Inc., for the protection of motors in domestic appliances are based primarily on the rules for protection of motors as given in the National Electrical Code. The requirements of the National Electrical Code, however, must be a type that can be administered by inspection authorities in the field, and therefore do not contemplate the evaluation of a specific motor application to the same degree that can be accomplished readily in a testing laboratory.

Until the time of the introduction of the automatic washing machine, very few domestic appliances submitted to Underwriters' Laboratories, Inc., were required to have overload protection. Most appliances were controlled manually, within sight of the operator, and not subjected to great fluctuation of loads. Since these appliances were under the supervision of the operator at the time of starting, the only motor protection required was the short-circuit protection provided by the branch circuit protective device.

Reports covering the analysis of fires which occurred in 30 large cities throughout the United States in 1951 indicated that 8,140 fires were of electrical origin. Of these, 2,661 fires or 32.7 per cent of the total were due to motor burnouts. In Chicago during 1952, 31.8 per cent of electrical fires in 1-story dwellings were reported as caused by electric motors. Increased use of motor protective devices on domestic appliances can be expected to reduce the number of fires caused by motor-operated appliances.

Full text of a conference paper presented at the AIEE Conference on Domestic Appliances, Louisville, Ky., April 22–24, 1953, and recommended for publication by the AIEE Committee on Domestic and Commercial Applications. Part I of a series.

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The conditions under which Underwriters' Laboratories, Inc., requires thermal or overcurrent protection for motors in domestic appliances, those under which an appliance is considered to be controlled automatically, those under which a hazard is considered to exist, and new conditions in the appliance which may be introduced by the installation of an overload protective device are discussed. Specific applications where motor protection is required on appliances are presented.

A similar situation was encountered several years ago in the use of the domestic electric flatiron. At one time the electric flatiron was considered to be responsible for more fires than any other electric appliance, because it was not generally provided with temperature-limiting or temperature-regulating devices. Since 1941 the automatic flatiron for domestic use has become quite common, and as a result the fire records now indicate that less than 2 per cent of the total electrical fires reported are chargeable to electric flatirons.

Motors in appliances, like motors elsewhere, require protection against short circuits, and, in some cases protection against overloads.

Short-circuit protection normally is provided by the fuses or circuit breakers installed in the branch circuit to which the appliance is connected. Because the rating of the branch-circuit protective device generally must be at least four times the full-load current of the motor, to permit the motor to get started, the degree of overload protection offered is limited.

Motors used in domestic appliances are of the type whose starting currents are from approximately six to eight times the normal full-load current of the motor. Under conditions of overload, slow acceleration, or long-time operation on start windings, the motor current is likely to be far in excess of the normal rated current of the motor. Since heating is a function of the square of the motor current, it is evident that overheating will result under these conditions. As long as the maximum temperature and the time of operation at elevated temperatures are both limited, reasonable insulation life and safe operation is to be expected. Motors in domestic appliances will handle moderate infrequent overloads safely for short periods of time. A Class *A* insulated motor, operating at temperatures over the prescribed limit of 105 degrees centigrade (hot-spot) for extended periods of time, causes accelerated deterioration of the insulation with attendant fire and shock hazards, including possible ignition of combustible material such as lint and dust which might contact the motor.

Overload protection, where required, may be provided by current-responsive devices mounted on the appliance but not necessarily on the motor, or devices integral with the motor responsive to motor current, or motor current and temperature. Motors in appliances submitted to Underwriters' Laboratories, Inc., are usually special-purpose motors designed for the particular application. The performance of any type of protective device is checked in conjunction with the motor it protects in each application to determine if it will limit the temperature of the motor under conditions of overload.

In determining the acceptability of any overload protective device, consideration is given to the intended use of the appliance, and to any other protective device which might be in the circuit and which would limit the time that the motor would be subjected to an overload.

Underwriters' Laboratories, Inc., has required thermal or overcurrent protection for motors in domestic appliances under the following conditions:

1. If the appliance is intended to be controlled remotely or automatically, and if the motor will become a hazard under any ordinary or severe overload, and if the appliance is likely to be so overloaded under conditions of actual service.

2. If the appliance is intended to be controlled remotely or automatically, and if the motor is a capacitor-run or capacitor-start motor, and if any hazard will result from either open circuit or short circuit of the capacitor.

An appliance has been considered to be controlled remotely if it is not within sight of the operator at the location of the starting device.

An appliance has been considered to be controlled automatically under any one or more of the following conditions:

1. If the repeated starting of the appliance beyond one complete predetermined cycle of operation to the point where some form of limit switch opens the circuit is independent of any manual control.

2. If, during any single predetermined cycle of operation, the motor is caused to stop and restart one or more times.

3. If, upon energizing the appliance, the initial starting of the motor may be intentionally delayed beyond normal conventional starting.

4. If, during any single predetermined cycle of operation, automatic changing of mechanical load may reduce the motor speed sufficiently to re-establish starting winding connections to the supply circuit.

A hazard has been considered to exist under the following conditions:

1. If, under any running overload condition, the temperatures on the coil of an open-type motor or on the enclosure of a totally enclosed motor is more than 125 degrees centigrade, or if temperatures exceed 150 degrees centigrade on motors of portable appliances and provided the motor is controlled by a limit switch or the equivalent which prevents operation for long periods under such an overload condition.

2. If, under any stalled rotor condition, the temperature on the coils of an open-type motor or on the enclosure of a totally enclosed motor is more than 150 degrees centigrade.

The installation of an overload protective device in an appliance may introduce new conditions in the appliance which must be considered. These are

1. Casualty hazards—if an automatic-reset type of protective device is employed, the automatic restarting of the motor must not result in any conditions of hazard to persons.

2. Nuisance trip—motor-operated appliance must start and operate in the intended manner without nuisance tripping of the proper size branch circuit fuse or circuit breaker or tripping of the overload protector. On a portable appliance the attachment plug cap defines the rating of the branch circuit. For a permanently installed device the branch circuit size is determined in accordance with the rules of the National Electrical Code (not more than 400 per cent of the motor full load current).

3. Short circuit—the overload protective device must not ignite combustible material when subjected to a short circuit limited to 200 amperes for a motor rated 1/2 horsepower or less, 250 volts or less (1,000 amperes for over 1/2 horsepower or over 250 volts), when connected in series with the proper size branch circuit fuse.

4. Arc rupture—the contacts of the protective device must be suitable for interrupting the stalled rotor current of the motor employed.

Specific applications where motor protection has been required on appliances are

1. Kitchen waste disposal units.
2. Dish washers.
3. Attic ventilating fans.
4. Washing machines.
5. Refrigerators.
6. Oil burners.

Kitchen waste disposal units have been required to be provided with overload protection on the basis that they are subjected to overloads under normal operating conditions. These appliances are manually controlled, and usually equipped with a short-time duty motor designed specifically for the application. The protective device is required to limit the temperature to 125 degrees centigrade under any overload running condition, and to 150 degrees centigrade under any stalled condition.

Automatic dish-washing machines are required to have protective devices for the motor which will limit the temperature to 125 degrees centigrade on the motor windings under running overload conditions if the likelihood of overloading is demonstrated, and limit the temperature on the motor to 150 degrees centigrade under stalled rotor conditions.

Attic ventilating fans are considered to be remotely controlled, and are required to be protected against stalled rotor currents only. Attic ventilating fans are not considered to be subjected to overloads normally.

Automatic washing machines generally have been required to have overload protection only if a capacitor-type motor is employed.

Domestic refrigerator compressor motors and oil-burning equipment are required to have protection equivalent to the protection required by the National Electrical Code. This protection must be provided as part of the refrigerator or oil-burner assembly. Auxiliary motors such as blower motors are not required to have separate protection if of a high-impedance type so that the temperature of the motor under stalled rotor conditions will not exceed 150 degrees centigrade.

Consideration has been given, of late, to the need of requiring thermal or overcurrent protection on electric clothes dryers because of the large amount of combustible material in the clothes being dried and the inherent danger of lint and dust accumulation in and around the motor.

A nonautomatic motor-operated appliance within sight of the operator, even if subjected to considerable variation of load, is not considered to present the same potential fire hazard as does the automatic or remotely installed appliance. This follows the generally accepted concept that the starting condition of a motor, or a severe overload condition, if permitted to exist for appreciable periods of time, as might result in automatic or remotely controlled devices, are the conditions most likely to produce fires and accidents. It is the objective of Underwriters' Laboratories, Inc., to classify those domestic appliances where such a potential hazard is likely to exist, and then to determine by suitable tests that adequate safeguards against such hazards are provided either in the motor or integral with the appliance.

Duo-Cone High-Fidelity Loudspeaker Eliminates Interference

Seven acoustical domes, indicated by Dr. H. F. Olson (right), director of acoustical research laboratory of RCA's David Sarnoff Research Center, Princeton, N. J., are unique new design features of the RCA type *LC-1A* Duo-Cone speaker, introduced to enhance further fidelity of sound reproduction. Speaker incorporating this innovation, the "Olson speaker," is part of the first RCA line of high-fidelity sound system components. The seven convex conelike protrusions deliberately spaced in a slightly irregular ring around the inside of the large low-frequency cone detour sound waves moving toward the outer rim of the speaker over paths that vary slightly in length. By thus preventing all segments of a given wave from reaching the rim at the same instant, the design eliminates the interference normally introduced by radiation from the rim. With Dr. Olson is John Preston, co-developer of the design. Behind them is electronic device used for measuring speaker frequency response

A Relative Damping Criterion for Linear Systems

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MANY FEEDBACK CONTROLS and other physical systems are designed on the basis of linear theory, that is, linear differential equations with constant coefficients. A. Leonhard[1-3] and A. Vazsonyi[4] have given graphical methods for determining whether all roots of the characteristic equation are located within certain sectors of the complex plane. Vazsonyi's method determines whether all dimensionless damping ratios ζ of any linear system are greater than any prescribed value. Each pair of complex conjugate roots of the characteristic equation of a linear system has its own value of ζ. Any such pair can be expressed as:

$$[-\zeta \pm j(1-\zeta^2)^{1/2}]\omega_n \qquad (1)$$

In equation 1, ω_n is the undamped natural frequency. $\zeta<1$ corresponds to an oscillatory transient response and $\zeta=1$ corresponds to critical damping.

In Figure 1 is shown the complex plane in which the roots of the characteristic equation may be plotted. A linear system is stable if, and only if, all roots of the characteristic equation have negative real parts. Consider a complex conjugate pair located on the boundaries of a symmetrical sector $\pi-2\beta$, Figure 1. This pair has a value of ζ:

$$\zeta = \sin\beta, \; 0 \le \beta \le \pi/2 \qquad (2)$$

If all roots are located within some sector $\pi-2\beta$, β fixed, then all roots have damping ratios greater than $\zeta = \sin\beta$. By use of either the Leonhard graphical method or the Vazsonyi graphical method one can determine the number of roots inside and outside each such sector $\pi-2\beta$.

This article presents two theorems, with proofs, which can be used to obtain the same information. The subject method is completely analytical. It consists of the determination of the coefficients of a continued fraction expansion, obtained by the process of long division. For example, assume that the criterion is to be applied to a system described by an nth degree characteristic equation, in order to determine the number of roots inside and outside the sector $\pi-2\beta$, β fixed, Figure 1. Apply the Routh criterion to determine if all roots have negative real parts. If they do, assume that the continued fraction expansion is found to be

$$\frac{Q(z)}{T(z)} = \cfrac{1}{c_1 z + k_1 + \cfrac{1}{c_2 z + k_2 + \cfrac{1}{\ddots + \cfrac{1}{c_n z + k_n}}}}$$

If r of the coefficients c_p are real and negative and $(n-r)$ are real and positive, and the k_p are pure imaginary or zero, then the nth degree characteristic equation has $2r$ complex roots outside the sector $\pi-2\beta$ and $(n-2r)$ real or complex roots inside the sector. If a value of β is chosen which corresponds to a pair of roots on the boundary of the sector $\pi-2\beta$ then the coefficients c_n and k_n will be zero.

An extension of this method is presented for the evaluation of the complex roots of any real or complex polynomial equation. This is related to a method by Wall.[5] Leonhard's graphical root-evaluation method is limited to the complex root pair, of any nth degree real polynomial equation, with the lowest frequency. The subject method can be used to evaluate any root pair, and in particular the root pair with the smallest damping ratio.

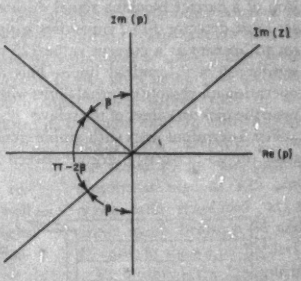

Figure 1. Superposed complex planes

By analogy with Leonhard's root-evaluation method, Vazsonyi's method can be extended in order to evaluate the root pair with the lowest frequency. All three methods will determine root values to any desired degree of accuracy.

When estimating the transient performance of linear systems, the criterion, presented here, for relative damping ratios ζ, often can be used instead of evaluation of the roots. Compared with root evaluation the method described is much less laborious.

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Phase Comparison Carrier Relaying

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THE ADDITION OF a third terminal or a transformer bank to a 2-terminal line section has economic advantages, but presents problems when using phase comparison carrier relaying on such a line. In this type of relaying, the phase angles of the currents at the line terminals are compared over a carrier channel. The 3-phase line currents feed a sequence network, the output of which energizes two fault detectors, *FD-1* and *FD-2*, and an electronic circuit to control the transmission of carrier. Operation of the low-set fault detector *FD-1* starts the transmission of a carrier blocking signal during a fault. The high-set fault detector *FD-2* supervises tripping and generally is set to operate at a current value 125 per cent of the *FD-1* setting on a 2-terminal line. This assures correct relay operation for remote external faults with current magnitudes near the pickup values of the relay.

For 3-terminal lines with ample generation at all terminals, the 25-per-cent margin between *FD-1* and *FD-2* is no longer sufficient. Consider an external fault beyond one terminal with equal values of fault current flowing in at the other two terminals. Under this condition, the ratio between the settings of *FD-2* and *FD-1* must be at least 2 to 1 to allow proper blocking. In order to provide the same percentage safety factor as for 2-terminal lines, *FD-2* must be set at 2 times 125 per cent or 250 per cent of *FD-1*. With a 75-per-cent dropout for *FD-1*, the ratio between minimum 3-phase fault and maximum load current becomes 2.5 divided by 0.75 or 333 per cent. This requirement is incorporated into the bar graph of Figure 1.

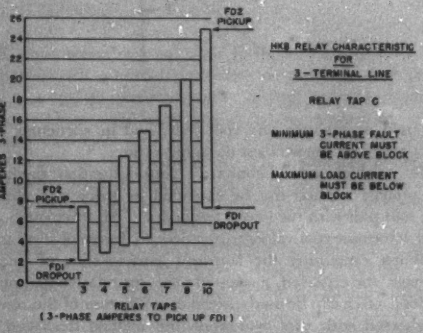

Figure 1. Characteristics of relay for operation on 3-terminal lines

The third terminal on a transmission line often is added to supply a load, and the generation or back-feed from this terminal may be quite small. In such a case, the settings previously described are generally not satisfactory because of the limited current from the third terminal. When the generation or back-feed at the third terminal is negligible, then phase comparison relaying set for 2-terminal operation may be applied to the two main terminals under certain conditions as set forth by Cheek and Blackburn:[1]

1. The maximum load current through relay *A* or *B* to the tap must be less than 25 per cent of the 3-phase carrier-start fault detector (*FD-1*) pickup current of the relays.

With 25-per-cent difference between *FD-1* and *FD-2* and a remote external fault, the tap load plus external fault current may exceed the tripping value at one end, while the fault current at the other terminal may be less than the carrier-start current. This will result in incorrect tripping of one end of the line. The limit on tap current is based on the worst condition which occurs when the load and fault currents add directly.

2. The maximum 3-phase current through either relay *A* or *B* for faults at the bus *C* must be less than 50 per cent of the 3-phase carrier-start fault detector pickup.

The second limitation results from the response of the relay to different phase-to-phase faults. When the relay taps are used which provide 3-phase pickup at tap value, the pickup for phase *A–B* and *C–A* faults is 86 per cent of tap value, but approximately 50 per cent for *B–C* faults. It is the relay response to *B–C* faults which makes the second limitation necessary.

If a large-capacity transformer is located at the tap, the relay at the two main stations may operate for a fault on the low-side bus at the tap. To prevent such undesirable operation, a carrier blocking terminal can be placed at the tap. With negligible back-feed from the tap, overcurrent relays are used to start a carrier transmitter which sends a continuous blocking signal back to the relays at the other two terminals for faults at or beyond the tap. The relays at the tap must not operate for internal faults on the line. A complete terminal of phase comparison relaying equipment is not necessary at the tap for this condition. If the line side of the transformer bank is grounded or if zero-sequence current can flow through the transformer bank, a directional-overcurrent ground blocking relay will then be required. Such a relay will start carrier only for faults beyond the tap station, but not for internal ground faults where zero-sequence current flows into the line from the transformer bank.

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An Axle-Driven Alternator-Rectifier System for Caboose Power Supply

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G. W. WEBER

THE APPLICATION OF 2-way telephone communication to moving railroad trains has created a need for a dependable power supply for railway cabooses. A study of the system requirements indicated an axle-drive alternator-rectifier equipment to be better suited to this application than the conventional d-c generator. A 3–5-kw alternator system has been developed, paying particular attention to the requirements of this service, and to the fact that the equipment must operate over long periods without attention.

SYSTEM REQUIREMENTS AND LIMITATIONS

THE PRIME REQUISITE OF a caboose power supply is reliability with a bare minimum of maintenance. Unlike the railway passenger car, the caboose receives a minimum of electrical attention and the periodic overhaul may not occur at stated intervals. For this reason the maintenance requirements of its electric system must be extremely low. This stipulation strongly discourages the use of a small engine-generator set with its need for regular fuel, lubrication, and coolant servicing. The alternative type of power supply system is the axle-driven generator with a large storage battery.

This new power system features high reliability, over-all simplicity, low initial as well as low maintenance costs, small size, light weight, and extreme speed range and versatility.

The system must provide full output over a very wide speed range. While it is expected that a large part of the operation will be at low speeds, as in drag freight service, one operator has specified a range from 10 to 90 miles per hour.

A third requirement is that the control be fully automatic. The generator must be self-excited and must build up at a speed below 8 miles per hour. The system must include both current-limit and voltage-control features to protect the battery and the charging equipment. At standstill the parasitic power drain from the battery must be very small to prevent discharging during long layovers.

GENERAL DESCRIPTION

THE AXLE-DRIVEN alternator-rectifier system pictured in Figure 1, with its schematic wiring diagram shown in Figure 2, includes the following components:

1. Axle-driven alternator, Figure 3.
2. Gear drive and centrifugal clutch, Figure 4.
3. Selenium rectifiers—power and control, Figure 5.
4. Rectifier fan.
5. Voltage control relay, Figure 6.
6. Current limit relay, Figure 6.
7. Line contactor, Figure 6.
8. 300-ampere-hour 32-volt battery.

This equipment, when applied to a caboose, is rated to produce a d-c output of 80 amperes. The voltage may be preset between 36 and 45 volts, over a speed range from 10 to 90 miles per hour. It also may be applied to other equipment on which a small power supply may be required, such as work-train, baggage, express, and railway postal cars. Depending on the speed range the output may be as high as 125 amperes, still regulated at a preset value between 36 and 45 volts, as shown in Table I.

Reliability is the keynote of the design. This is evidenced by the choice of a totally enclosed alternator with a gear-type drive, and a relatively large 300-ampere-hour 32-volt battery.

OPERATION

THE ALTERNATOR IS mounted under the caboose, Figure 4, and driven from the axle by an outboard-type double-reduction gear unit with a 5.28 to 1 gear ratio. A splined propeller shaft with universal joints provides for the movement of the truck relative to the car body. When the axle drive reaches a predetermined speed, somewhat below the voltage cut-in speed of the alternator, the centrifugal clutch engages and connects the gear drive to the alternator.

Table I. Alternator-Rectifier System Performance*

	Gear Ratio			
	2.54	3.09	3.44	5.28
Rated d-c output—amperes	125	125	125	80
Rated d-c output—volts	40	40	40	40
Maximum regulated d-c output—volts	45	45	45	45
Wheel diameter, inches—maximum	36	36	36	33
Wheel diameter, inches—minimum	33	33	33	31.5
Maximum permissible speed—miles per hour	135	111	100	90
Minimum continuous speed—miles per hour	30	25	22	10
Minimum full-load cut-in speed—miles per hour, 25 degrees centigrade	25	21	18	9.5
Minimum voltage cut-in speed—miles per hour, 32 volts d-c, no load	18	15	14	8

* These ratings are obtained from a single alternator. Rectifier size and capacity increase with the full-load current rating.

Full text of paper 53-78, "An Axle-Driven Alternator-Rectifier System for Caboose Power Supply," recommended by the AIEE Committee on Land Transportation and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 19–23, 1953. Scheduled for publication in AIEE *Transactions*, volume 72, 1953.

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Figure 1. Sample axle-driven alternator mounted under a caboose

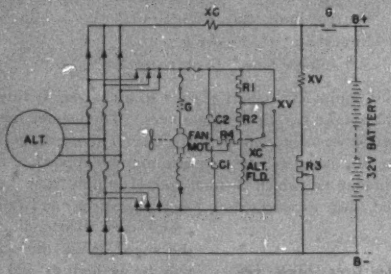


Figure 2. Schematic diagram

With the small residual flux in the alternator fixed by design, the system constants are such that the alternator voltage will build up at some speed below 430 rpm (8 miles per hour with 5.28 gear ratio and 33-inch wheels). A selenium rectifier in series with the rectifier fan isolates the fan from the field circuit during build-up. This permits the use of a common field and fan rectifier with no appreciable decrease in the build-up speed. As the voltage builds up, the rectifier fan starts and the line contactor closes, actuated by the fan motor current. When the rectified voltage exceeds the voltage of the battery, direct current begins to flow to the battery and its connected load. When the rectified voltage tends to exceed the desired charging voltage, the voltage-control relay begins reducing the alternator field current by opening its normally closed contact intermittently, thus inserting resistance in the field circuit. A further reduction of field current to essentially zero is possible when the normally open contacts begin short-circuiting the field intermittently. The current relay acts in an exactly similar manner when the desired maximum load current is exceeded, reducing voltage to hold constant current. Note that when the current-limit relay reduces the voltage to a value less than the setting of the voltage-control relay, the latter is inactive and the former has complete control. Capacitors *C1* and *C2*, and resistor *R4* form an arc-suppression circuit for the contacts of both relays. Voltage adjustment over the range required by 32-volt lead-acid or nickel-alkaline batteries is accomplished by means of adjustable resistor *R3*.

When the train slows down and the alternator speed falls, a point is reached where the alternator no longer can hold full voltage. The load current falls to zero when the rectified voltage falls below the battery voltage, and reverse current is blocked by the rectifiers. When the voltage of the control rectifier reaches a very low value, the line contactor will disconnect the battery and its load from the system. The rectifier fan will stop also. The primary function of the line contactor is to remove the rectifier leakage and the voltage relay coil loads from the battery while the equipment is idle. In case of fan failure resulting from a locked rotor, the fan fuse will blow, de-energizing the line contactor coil. Similarly, any failure that opens this circuit also will de-energize the line contactor coil. Thus the rectifiers are protected against damage by fan failure from any cause.

A 3-phase full-wave bridge of selenium rectifiers is used to provide high efficiency and a low a-c ripple in the d-c output. Six 40-ampere time-delay fuses protect the individual branches of the bridge. This provides closer, faster protection for both the a-c and d-c circuits than would be possible with a single fuse of larger size. The selenium rectifier stacks have a special vapor-resistant coating to reduce damage from moisture and corrosive vapors.

COMPARISON OF THE ALTERNATOR-RECTIFIER AND D-C GENERATOR SYSTEMS

For the purpose of evaluating these two systems, the alternator-rectifier system will be compared to a typical d-c machine, also totally enclosed and capable of performing the same service. The fundamental difference between the alternator and the d-c generator lies in the location of the power windings and rectifying devices. From this stem many of the advantages that the alternator enjoys.

Brushes. The d-c machine has its power windings located in the rotating armature, necessitating a commutator and

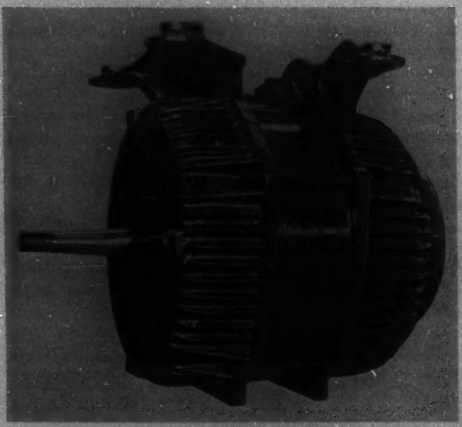
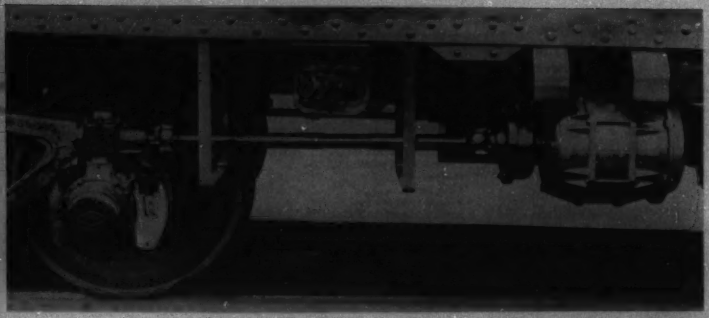


Figure 3. Exterior of alternator



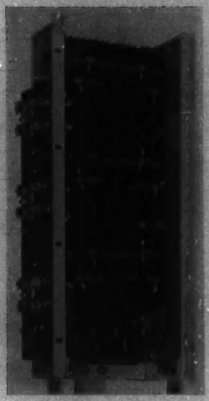


Figure 4 (above). Close-up of caboose installation, showing gear drive, centrifugal clutch, and sample alternator. Figure 5 (right). Selenium rectifier group

a high-current-collecting brush-rigging with a multiplicity of brushes. These introduce high friction and contact losses as well as high brush maintenance. The a-c machine has its power windings located in the stator, and only a small exciting current need be carried to slip rings by the brushes. The brush drop loss at full load is reduced from 176 to 3 watts, and the brush friction loss at maximum speed is reduced from 350 to 16 watts.

Power Conversion. The d-c machine rectifies its power from alternating to direct current by its commutator. The ability of a machine to commutate well depends, to a great measure, on the reactance voltage per bar. This voltage varies directly with the speed, the load current, the number of poles, and the number of commutator bars. It also varies with the square of the number of turns per armature coil. As the full-output speed range of a d-c machine is widened, it becomes increasingly more difficult to obtain good commutation and long brush life at the high-speed end of the range.

The a-c machine has its power rectified externally, and hence has no commutator. Therefore, it requires no space for a commutator and no extra surface area to dissipate commutator losses. Also, since it has no speed limitation imposed by difficulties in obtaining good commutation, the a-c machine can be made considerably smaller and lighter than its d-c counterpart.

Compartmentation. In a totally enclosed d-c machine, air from the main body of the machine must be blown over the commutator to keep it cool. This air becomes contaminated with carbon dust, some of which is deposited on the insulating surfaces of the machine. This results in reduced creepage resistance and the danger of dielectric breakdown.

In the alternator the slip-ring losses are low, allowing the rings and brushes to be isolated in a separate chamber. Thus the carbon dust—which, incidentally, is far less with slip rings than with commutators—can be kept away from all the windings.

Field Windings. The alternator is simple in construction and operation. It has only one field coil which excites all of the pairs of poles in parallel. It requires no series, differential, or commutating field windings, such as may be required by the d-c machine.

Stability. A d-c machine is considered unstable if at any speed its excitation requirements decrease for an increase in load. As the speed range increases, it becomes progressively more difficult to design a stable d-c machine. The alternator-rectifier system, on the other hand, is inherently stable at all speeds and can produce full output over an extreme range of load and speed without the need of stabilizing windings.

Control Features. The control for an alternator-rectifier system is inherently simpler than that for a d-c generator. Since the alternator output is alternating current, no polarity reversing switch is required. Furthermore, the valve action of the rectifiers prevents the flow of reverse current, thus eliminating the usual reverse current relay.

Another potential advantage of the a-c system lies in the fact that the presence of an a-c power supply makes

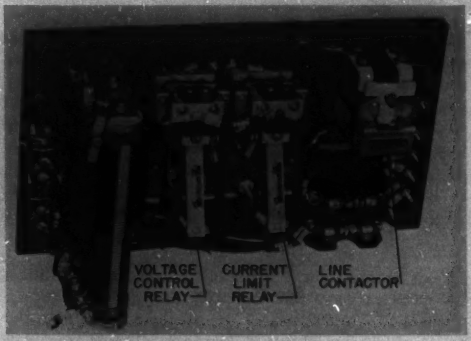


Figure 6. Control panel

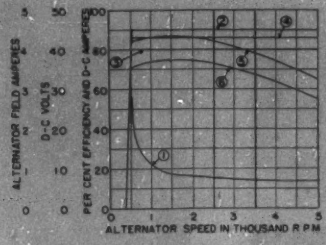


Figure 7. System performance curves

1. *Field amperes*
2. *Direct voltage*
3. *D-c load amperes*
4. *Rectifier efficiency*
5. *Alternator efficiency*
6. *System efficiency*

Table II. Comparison of Typical A-C and D-C System Losses†

Item	Alternating Current (in Watts)	Direct Current (in Watts)
Brush contact drop loss	3	176
Brush friction loss	2	40
Windage loss	4	3
Armature copper loss	350	356
Field copper loss	48	442
Commutating pole copper loss	0	146
No-load core loss	101	21
Load loss	40	18
Rectifier and fan loss	720	0
Reverse current relay loss	0	15
Regulator loss	64	360
Total	1,332	1,577
Efficiency, per cent	70.6	67.0

† Based on net output of 80 amperes at 40-volts direct current at 10 miles per hour

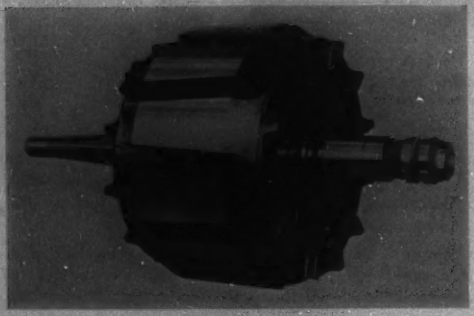


Figure 8. Rotor assembled on shaft

possible the development of a completely static regulator and the elimination of all contact-making devices. However, the system now in use, as shown in Figures 2 and 6, employs the vibrating-type voltage and current relays.

Initial Cost. The maximum speed-range at full load establishes the size and cost of the system. The combination of the a-c machine with its external rectifier is comparable in cost to the d-c machine alone. Moreover, since the field current requirements of an a-c machine are less than that of its d-c counterpart, a less expensive regulator can be used.

System Efficiency. The over-all efficiency of the alternator-rectifier system at the low speeds which generally characterize freight service is greater than that of the d-c generator system. Table II compares the losses in the two systems, and Figure 7 shows how the a-c system efficiency varies with speed. In the middle of the speed range the efficiencies of the two systems are almost identical. At extremely high speeds the efficiency of the a-c system is slightly less than that of the d-c system. However, operation at these speeds is rare.

ALTERNATOR DESIGN

THIS ALTERNATOR IS a 12-pole 3.2-kw machine with a speed range of 537 to 5,070 rpm, and a frequency range of 53.7 to 507 cycles. Its simplicity stems from the design of its rotor, shown in Figure 8. This is assembled by pressing two similar 6-legged castings onto the ends of a prewound rotor sleeve which, in turn, is pressed onto a shaft. The 12 tapered field poles are essentially fixed cantilevers, very sturdy in construction and offering high resistance to centrifugal forces. The rotor magnetic circuit was especially designed to require very little exciting power. This minimized the size and cost of the regulator. Since all the pairs of poles are excited in parallel by a single field coil, the alternator requires much less field power than does the d-c machine. As previously indicated, care was taken in choosing the magnetic materials for the rotor to provide just the right amount of residual flux to make the machine build up at low speeds and yet not provide an overvoltage at no load and high speed.

The leads of the single field coil are brought out through shallow slots in the shaft to the slip-ring assembly which is housed in a separate brush-holder compartment. The slip-ring assembly consists of two brass rings molded in resin. The rings are presprayed with molten copper to increase their surface hardness and decrease their friction

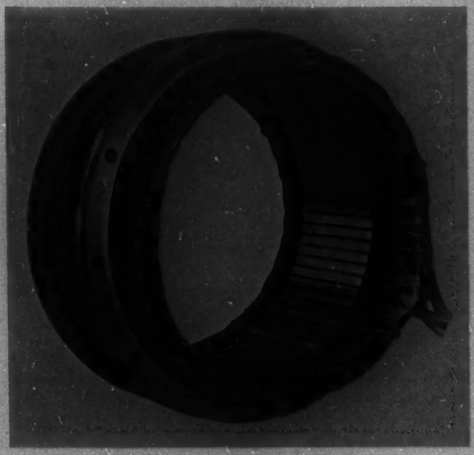


Figure 9. Completely wound stator

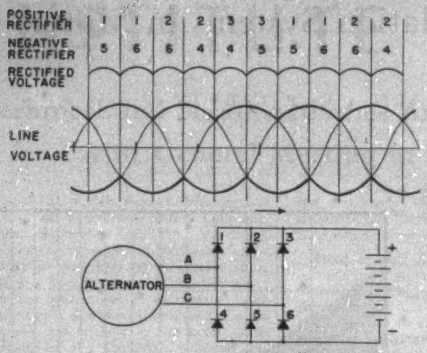


Figure 10. Sequence diagram for 3-phase full-wave rectifier

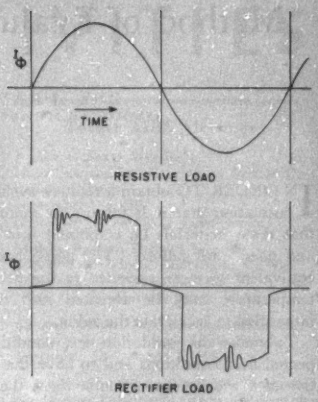


Figure 11. Typical waveforms of alternator phase current with resistive and rectifier loads

and contact drop. Two brushes, at right angles, ride each ring to provide positive current collection and prevent arcing at the rings. Each brush is 2 inches long, and the wear rate is extremely low. Each of the four brush holders is securely bolted to integrally cast framehead studs to prevent misalignment. Field tests indicate that a set of rings and brushes may last for many years so that need for brush maintenance is reduced almost to the vanishing point.

In designing the stator, see Figure 9, for this machine, 72 slots were chosen since this yields a large number of voltage and current combinations should it be desired to rewind the machine to supply a different voltage system. The high number of slots also minimizes the stator leakage reactance and the load loss. The stator windings are Y-connected to give the lowest cutin speed for the alternator and to prevent circulating currents. Class *B* insulation is used throughout.

This machine was designed with a large air gap to minimize the load loss in the solid pole faces which varies inversely as the square of the air-gap length.

The line current waveform of an alternator loading into rectifiers is not the same as that for one loading into a balanced resistive load. When a sine-wave alternator loads into a balanced resistive load, the current waveform is identical with and in phase with the impressed voltage waveform. In an alternator loading into a 3-phase full-wave bridge of rectifiers, the current at any instant flows only in the phase which is most positive and the phase which is most negative while no current flows in the third phase, Figure 10. Every 60 electrical degrees, or six times every cycle, one rectifier stops conducting and another starts. Every time a rectifier cuts in, a transient oscillation appears in the line current, see Figure 11, whose time constant is determined by the inductance, capacitance, and resistance of the circuit. The amplitude of these transients increases directly with load and speed. The recitfiers can handle them easily, but the air gap of the alternator must be made large to limit the load loss introduced. The solid poles act as amortisseur windings to damp out these transients and to minimize their effect.

The over-all dimensions of the alternator are: height $20^{7}/_{16}$ inches, width 21 inches, and length 24 inches. The complete machine weighs 408 pounds.

Long experience in the design of railway equipment has proved the totally enclosed design to be the most satisfactory, hence it was used on this equipment. The machine is completely sealed with neoprene gaskets to keep out dirt and moisture. For better cooling, its nonmagnetic aluminum frameheads are ribbed inside and out, as shown in Figure 3. Fan blades, cast integral with each end of the rotor, see Figure 8, circulate air through the stator and windings and return it to be cooled against the framehead ribs.

The machine is fitted with two similar heavy-duty prelubricated ball bearings. Here again, ease of assembly and disassembly was kept in mind. The slip-ring end bearing pulls off over the slip rings without disturbing them. The outer race of the drive end bearing is securely clamped, while a special anticreep device prevents the outer race of the slip-ring end bearing from rotating, yet allows it axial freedom to compensate for thermal expansion of the rotor.

The alternator is hung under the side of the caboose, and is isolated from body vibration by four rubber mounts.

CONCLUSION

A SAMPLE EQUIPMENT of similar design has been operating successfully on a major railroad for over a year. Additional equipments are currently being supplied. Some of the outstanding features of this new system are high reliability, over-all simplicity, low maintenance, low initial cost, small size, light weight, and extreme speed range and versatility.

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Method of Evaluating Insulation Systems in Motors

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IN ORDER TO obtain a relative evaluation of electrical insulation materials for use in motors, it is necessary that these materials be combined into insulation systems and aged until failure. The aging conditions should be equivalent to those expected in the field except that the temperature may be elevated and the humidification intensified to accelerate the aging.

To make the insulation test conditions approach expected field conditions and to have the results representative of a wide range of motor sizes, the insulation system is aged in 5-horsepower 440-volt 60-cycle squirrel-cage motors.

The aging consists of alternate periods of heat run and humidification until the motor fails. The elevated, aging temperature during the heat run is obtained and held by reversing the motor every 6 seconds when its temperature is below the setting of a controlling instrument.

As the motor insulation ages, it is inspected for physical changes and is measured electrically for insulation resistance, capacitance, and dissipation factor. These measurements, made at elevated temperatures, give a sensitive indication as to the degree of embrittlement of the insulation. This is indicated in Figure 1 showing curves of capacitance and dissipation factor measurements for cycles of aging. Similarly a curve of insulation resistance versus aging can be plotted showing how the insulation resistance increases with gradual embrittlement of the insulation. By comparing the characteristics of these curves for various insulation systems their relative rates of aging may be determined at lower temperatures without aging the insulation system until failure at these lower temperatures.

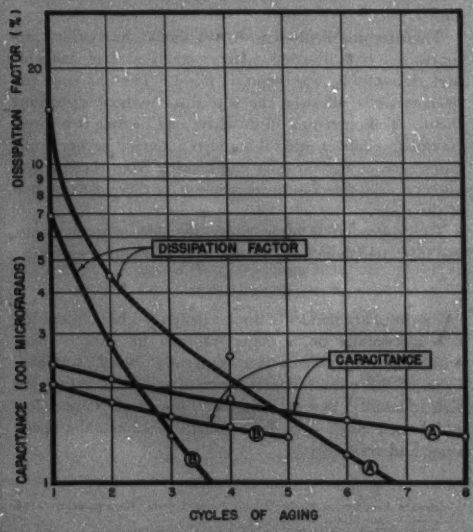

Figure 1. Capacitance and dissipation factor to ground versus cycles of aging for systems A and B. The measurements were made at 160 degrees centigrade during cooling after the heat runs

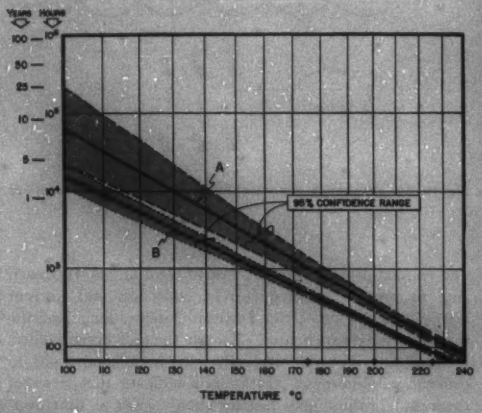

Figure 2. Insulation life versus temperature for insulation systems A and B. (The temperature in degrees centigrade is plotted on an inverse absolute temperature scale.) The aging temperatures are 175, 200, and 225 degrees centigrade

Figure 2 shows temperature-life curves for two insulation systems. These curves were made by plotting the life of the insulation system, determined at 175, 200, and 225 degrees centigrade, against aging temperature on an inverse absolute temperature scale and extrapolating to the lower temperatures. By these curves it is possible to obtain an estimate of insulation system life under operating conditions which approach those in the field.

In addition to obtaining insulation system life, this method allows an accurate evaluation of preliminary empirical laboratory tests on insulation components. Since it is possible to determine in the stator winding the location and frequently the initial cause or mechanism of the failure, preliminary laboratory tests can be correlated to motor-winding failure conditions.

Digest of paper 53-207, "A Method of Evaluating Insulation Systems in Motors," recommended by the AIEE Committee on Rotating Machinery and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer General Meeting, Atlantic City, N. J., June 15–19, 1953. Scheduled for publication in AIEE *Transactions*, volume 72, 1953.

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INSTITUTE ACTIVITIES

Technical and Social Activities Announced for Pacific General Meeting in Vancouver

The AIEE Pacific General Meeting will be held in Vancouver, British Columbia, Canada, September 1–4, 1953. Vancouver is situated on the shores of the Pacific with a spectacular backdrop of mountains rising 5,000 feet from the ocean. The Vancouver Hotel has been chosen for the meeting headquarters and all technical sessions and social functions will be held in this hotel jointly operated by the Canadian National and Canadian Pacific Railways.

INSPECTION TRIPS

345-Kv Transmission Line From Wahleach to T. Ingledow Station. One of the first transmission lines to be built in North America at this voltage. This line extends through the fertile Fraser River Valley to the generating station situated on the edge of the mountains.

Wahleach Supervised Automatic Generating Station. This station operates on the highest hydraulic head of any major unit in Canada. It is also the largest unit with vertical shaft impulse waterwheel. This station has been opened just recently and embraces many unique design features of general interest.

Lake Buntzen Automatic Supervised Generating Unit. The highest speed umbrella-type generator yet built. This station is reached after a picturesque boat trip through inland waters out of Vancouver.

Dal Grauer Substation. This interesting installation just completed in the heart of Vancouver is notable for its modern exterior design with a plate-glass front enabling passersby to observe the operations of a modern substation. Even the colors are a radical departure from the usual standards.

Oak Ridge Transportation Center. The heart of one of the largest and most modern trolley-bus and motor-bus transportation centers on the continent. To those interested in the transportation field, many interesting features will be observed.

Forest Products Industry. Wood products are the most important industry in British Columbia and visits will be made to some of the larger sawmills and plywood mills. The electrical and mechanical features of these large operations which reduce 6-foot logs to small pieces of lumber in a matter of minutes, are always of interest to visitors from non-forest areas.

Howe Sound Boat Trip. A supervised inspection tour by steamship of two major industries, a large copper mine and a pulp mill, can be made in 1 day from Vancouver. The boat stops at Brittannia Mining and Smelting Company Ltd. and at Alaska Pine and Cellulose Company Ltd. mills. A first-hand trip through either of these operations will be available.

Van de Graaf Generator at University of British Columbia. This Van de Graaf generator was installed recently at the university and may be of interest to some visitors. Other facilities at the university will be open to AIEE visitors.

T. H. Crosby will be in charge of inspection trips.

SOCIAL ACTIVITIES AND SPORTS

Several social activities have been arranged for both the ladies and the members under the chairmanship of C. E. Woolgar.

On Tuesday, cocktails will be followed by a dinner-dance on the Panorama Roof of the Vancouver Hotel. Entertainment by the "Theater Under the Stars" group will be featured. Price per ticket is $6 each at the ticket desk.

The President's reception will be held on Thursday, September 3, and will consist of a cocktail hour followed by a dinner in the Banquet Room of the Vancouver Hotel. After the dinner there will be dancing in the Ballroom. Tickets will be $4 each.

For other activities, the Information Committee will provide data as to various boat and sight-seeing trips which are readily available, and the Ladies' Committee has made preparations for sight-seeing tours and teas to be held September 1 to 3 for the ladies.

A sports program also has been planned by the Entertainment Committee.

A golf tournament will be held at Quilchena Golf Club on Thursday afternoon, September 3. Green fees will be $3.50 each

Workman installing a potential transformer in the Dal Grauer Substation which is scheduled for inspection during the Pacific General Meeting in Vancouver

Future AIEE Meetings

Pacific General Meeting
Hotel Vancouver, Vancouver, British Columbia, Canada
September 1–4, 1953
(*Final date for submitting papers—closed*)

Middle Eastern District Meeting
Daniel Boone Hotel, Charleston, W. Va.
September 29–October 1, 1953
(*Final date for submitting papers—closed*)

Aircraft Electric Equipment Conference
Benjamin Franklin Hotel, Seattle, Wash.
September 30–October 2, 1953

Conference on the Application of Motors to Air-Moving Equipment and Symposium on Induction Motors
Hotel Van Orman, Fort Wayne, Ind.
October 6–8, 1953

Conference on Machine Tools
Cleveland Hotel, Cleveland, Ohio
October 14–16, 1953

Textile Industry Conference on Electric Equipment
North Carolina State College, Riddick Laboratories Auditorium, Raleigh, N. C.
October 29–30, 1953.

Fall General Meeting
Muehlebach Hotel, Kansas City, Mo.
November 2–6, 1953
(*Final date for submitting papers—closed*)

AIEE-IRE Conference on Electronic Instrumentation in Nucleonics and Medicine
New Yorker Hotel, New York, N. Y.
November 18–20, 1953

AIEE-IRE-ACM Eastern Computer Conference
Statler Hotel, Washington, D. C.
December 8–10, 1953

Winter General Meeting
Statler Hotel, New York, N. Y.
January 18–22, 1954

Conference on Feedback Control
Claridge Hotel, Atlantic City, N. J.
April 22–23, 1954

Summer General Meeting
Los Angeles, Calif.
June 21–25, 1954

Arrangements will be made for visitors to play on any of the local golf courses during their stay in Vancouver.

A salmon derby has been organized and will be held on Friday, September 4. An excellent fishing ground about 10 miles from Vancouver will be the site and transportation will be provided for all guests.

RESERVATIONS AND REGISTRATION

Vancouver is part of the famed evergreen playground and hotel and transportation accommodations are of the best. The city can be reached by train, airplane, or bus from the east and the south, and also by boat from the south.

The registration desk in the Hotel Vancouver will open on the evening of Monday, August 31, and will be open daily thereafter during convention hours. The registration fee will be $3 for members and $5 for nonmembers. Student members and members' families may register without payment of a fee.

STUDENTS

A separate program has been outlined for Student members which will involve both technical papers and entertainment.

COMMITTEE

The members of the Pacific General Meeting Committee are: T. Ingledow, Vice-President, District 9; J. H. Steede, general chairman; L. B. Stacey, vice-chairman and finance; H. O. Bulmer, secretary; W. J. Lind, treasurer; F. O. Wollaston, technical program; T. H. Crosby, inspection trips; C. E. Woolgar, entertainment; E. Wolstencroft, registration; D. S. Smith, hotels; F. D. Bolton, publicity; J. T. Turner, transportation; S. C. Morgan, Students; F. J. Bartholomew, J. B. Hedley, E. W. Johnson, Dr. H. J. MacLeod, members-at-large.

—PAMPHLET reproductions of authors' manuscripts of the numbered papers listed in the program may be obtained from AIEE Order Department, 33 West 39th Street, New York 18, N. Y., as noted in the following paragraphs.

—PRICES of papers, irrespective of length, are 30 cents to members (60 cents to nonmembers) whether ordered by mail or purchased at the meeting. Mail orders are advisable, particularly from out-of-town members, as an adequate supply of each paper at the meeting cannot be assured. Only numbered papers are available in pamphlet form.

—COUPON books in nine-dollar denominations are available for those who may wish this convenient form of remittance.

—THE PAPERS regularly approved by the Technical Operations Committee ultimately will be published in the bimonthly publications and Transactions; also, each is scheduled to be published in Electrical Engineering in digest or other form.

Tentative Technical Program

Pacific General Meeting, Vancouver, Sept. 1-4

Tuesday, September 1

10:00 a.m. General Session

2:00 p.m. Relays

53-312. A Simplified Unit for Distance Relaying. *A. W. Adams*, Bonneville Power Administration; *F. R. Bergseth*, University of Washington

CP.* Limitations of Back-up Relaying. *A. Rohrmoser*, Canadian Westinghouse Company, Ltd.; *C. G. Mills*, British Columbia Electric Company, Ltd.

53-314. Characteristics of Split-Phase Currents as a Source of Generator Protection. *H. R. Stile, J. L. McKeever*, Canadian General Electric Company, Ltd.

53-315. Dependable Pilot-Wire Relay Operation. *M. A. Bostwick*, Portland General Electric Company

2:00 p.m. General Industry and Radio

CP.* Development and Operation of Reda Submergible Pumps. *Joe Carle*, Reda Pump Company

53-316. The Magnetic-Amplifier Controlled Log Carriage Drive and the "Basic-Duty-Cycle" of Carriage Performance. *H. A. Rose*, Westinghouse Electric Corporation

CP.* 170-Megacycle Radiation Survey for Mobile Coverage of the Bonneville System. *D. R. Wilson, D. E. Johnston*, Portland, Oreg.

53-317. Some Aspects of Joint Use of Wood Pole Lines With Increasing Line Voltages. *W. E. Blocker*, American Telephone and Telegraph Company; *W. R. Bullard*, Ebasco Services, Inc.

53-356. The Measurements of Random Monochrome Video Interference. *J. M. Barstow, H. N. Christopher*, Bell Telephone Laboratories, Inc.

2:00 p.m. Rotating Equipment and Land Transportation

53-318. Techniques and Examples of High-Voltage D-C Testing of Rotating Machine Windings. *C. L. Sidney, B. R. Lasley*, Southern California Edison Company

CP.* Rating Induction Motors for Reversing Service. *T. N. Sakellarion, E. Zucker*, Canadian Westinghouse Company, Ltd.

53-320. Calculation of Dynamic Braking Characteristics of Wound-Rotor Induction Motors. *Paul Cochrun*, Westinghouse Electric Corporation

CP.* Progress Report on the General Electric Gas-Turbine Electric Locomotive. *J. E. Wilson*, General Electric Company

*CP: Conference paper; no advance copies are available; not intended for publication in *Transactions*.

Wednesday, September 2

9:30 a.m. Power Generation

53-321. Electrical Aspects of Alcan's Kemano-Kitimat Hydroelectric Power Development. *F. L. Lawton*, Aluminum Laboratories, Ltd.

CP.* Application of the Induction Generator. *J. V. Kresser*, Westinghouse Electric Corporation; *J. R. Dunning*, Portland General Electric Company

53-322. Automatic Control of Hydroelectric Induction Generators. *J. G. Kirwan*, Westinghouse Electric Corporation; *W. D. Smith*, Portland General Electric Company

CP.* Tests and Operating Experiences at the Ottawa River Plants of the Hydro-Electric Power Commission of Ontario. *J. J. Traill, F. C. Lawton, H. C. Rose, G. B. Tebo*, The Hydro-Electric Power Commission of Ontario

9:30 a.m. Carrier Current—Microwave

Chairman: S. C. Leyland

Discussion leader, together with a supporting panel of six specialists, will present a project subcommittee paper on the subject of "Installation and Operating Experience of Microwave for Power Systems." Discussion of this presentation will stimulate a question and answer period covering the various intricate problems that may be involved in the construction, operation, and maintenance of microwave applications.

9:30 a.m. Chemical and Electrochemical

53-323. Automatic Control of Gas Turbines for Natural-Gas Pipe-Line Pumping. *C. R. Ingemanson, Arne Loft, H. J. Wilt*, General Electric Company

53-324. Reactor Control of Industrial Electrostatic Precipitators. *W. H. Strutz*, Westinghouse Electric Corporation

53-325. Electrical Utilization in the Alberta Oil Industry. *G. H. Milligan*, Calgary Power Ltd.

CP.* Regulations Governing Electrical Installations in Oil Fields (Alberta). *S. A. B. Kembry*, Province of Alberta, Canada

2:00 p.m. Power Generation

53-326. Short-Range Economic Operation of a Combined Thermal and Hydroelectric Power System. *W. G. Chandler, P. L. Dandeno*, Hydro-Electric Power Commission of Ontario; *A. F. Glimn, L. K. Kirchmayer*, General Electric Company

53-327. The Wahleach Hydroelectric Development. *T. Ingledew, J. H. Steede*, British Columbia Electric Company, Ltd.

53-328. Experience Gained With the Swedish 400-Kv Power Transmission and the Novel Features of the System. *B. G. Rathman, G. Janckz*, Swedish State Power Board

2:00 p.m. Carrier Current

Chairman: C. W. Boadway

Discussion leader, together with a supporting panel of six specialists, will present a project subcommittee paper on the subject of "Application Guide for Power-Line Carrier." Discussion of this presentation will stimulate a question and answer period covering the various intricate problems that may be involved in the construction, operation, and maintenance of power-line carrier applications.

2:00 p.m. Chemical and Electrochemical, also Wiring and Metal Industry

53-329. Grounding Practices on 480-Volt Portable Distribution Systems. *R. B. Bennett*, General Electric Company

CP.* Power for Reynolds Metals Company's Aluminum Reduction Plants at Longview, Wash., and Troutdale, Oreg. *George Perkins*

CP.* Practical Welding Techniques for Aluminum Bus Bar Used in Aluminum Reduction Plants. *R. O. Beaudette*, Kaiser Aluminum and Chemical Corporation

CP.* The Use of Aluminum Bus and Cable in a Modern Aluminum Smelting Plant. *Waldo Porter*, Aluminum Company of America

Thursday, September 3

9:30 a.m. Transmission and Distribution

53-310. Aluminum-Sheathed Type S-A Gas Pressurized 69-Kv Cable for Vancouver. *F. O. Wollaston*, British Columbia Electric Railway Co., Ltd.; *H. D. Short*, Canada Wire and Cable Company

53-330. D-C Power Transmission. *J. G. Holm*, Quito, Ecuador

53-331. Effect of Fault Resistance on Ground Current. *M. J. Lantz*, Bonneville Power Administration

53-332. Location of Series Capacitors in High-Voltage Transmission Systems. *S. B. Crary, L. E. Salins*, General Electric Company

9:30 a.m. Wire Communications

CP.* 24-Channel Single-Side-Band System for Exchange and Toll Cable Use. *R. S. Caruthers*, Lenkurt Electric Company, Inc.

53-333. Type-ON Carrier Telephone. *R. D. Fracassi, H. Kahl*, Bell Telephone Laboratories, Inc.

53-334. Type N Carrier Telephone Deviation Regulator. *E. H. Perkins, J. J. Mahoney*, Bell Telephone Laboratories, Inc.

53-335. Program Transmission Over Type N Carrier Telephone. *R. L. Case, Iden Kerney*, Bell Telephone Laboratories, Inc.

9:30 a.m. Magnetic Amplifiers

53-336. Fast Response With Magnetic Amplifiers. *D. G. Szorgis*, Naval Research Laboratories

53-337. Flux Preset High-Speed Magnetic Amplifiers. *C. B. House*, Naval Research Laboratories

53-339. A Magnetic Amplifier for Synchros. *R. L. Van Allen*, Naval Research Laboratories

2:00 p.m. Transmission and Distribution

53-338. Practical Concepts in Capability and Performance of Transmission Lines. *H. P. St. Clair*, American Gas and Electric Service Corporation

53-340. Shunt Capacitors in Large Transmission Networks. *E. C. Starr*, Oregon State College; *E. J. Harrington*, Bonneville Power Administration

53-341. Economics of Transmission-Line Maintenance and Repair by Helicopter. *L. M. Alexander*, Bureau of Reclamation Region III; *O. K. Mangum*, United States Bureau of Reclamation

CP.* Connector Corrosion and Aluminum to Copper Joints on Transmission and Distribution Circuits. *D. C. Hubbard*, A. B. Chance Company

2:00 p.m. Wire Communications

53-342. Railroad Communications Using High-Power Carrier Technique. *A. K. Hanson*, Quebec North Shore and Labrador Railway; *W. W. H. Dean*, Canadian Westinghouse Company, Ltd.; *F. G. Mullins*, Westinghouse Electric Corporation

CP.* Inductance and Resistance Measurements on Small Size ACSR Cables at Frequencies From 10-160 Kc Per Second. *S. B. Thomas, M. R. Pynt*, Northern Electric Company, Ltd.

CP.* Common Control and the Strowger System. *C. F. Ffolliott*, Automatic Electric Company

53-344. Heat Dissipation From Toll Transmission Equipment. *J. A. Coy*, Bell Telephone Laboratories, Inc.

2:00 p.m. Electrical Techniques in Medicine and Biology

53-313. A Study of the Hazards of Impulse Currents. *C. F. Dalziel*, University of California

CP.* Tracing the Electrical Activity of the Heart. *A. M. Scher, R. R. Paine, A. C. Young*

CP.* Physical and Engineering Aspects of Cobalt 60 Beam Therapy. *H. F. Bates*, British Columbia Cancer Institute

CP.* Some Electrical Techniques Applied to Medicine. *E. T. Feldsted, F. H. MacGillivray*

Friday, September 4

9:30 a.m. Switchgear

53-346. Is the European Circuit Breaker Rating System Really More Conservative Than the American? *R. C. Van Sickle*, Westinghouse Electric Corporation

53-347. Short-Time Impulse Voltage Characteristics of Tank-Type Oil Circuit Breakers. *V. E. Phillips, R. H. Miller*, General Electric Company

CP.* The Application of Analytical Methods in Power Circuit Breaker Mechanism Design. *R. R. Bush, G. K. Carter*, General Electric Company

53-349. A 230-Kv–10,000-Megavolt-Ampere Steel-Clad Impulse Circuit Breaker; Another Rating in a Line of High-Capacity High-Voltage Breakers. *C. J. Balentine, J. M. Milne*, General Electric Company

53-348. Oil Circuit Breaker for Switching 115-Kv Shunt Capacitors. *W. M. Leeds, J. H. Pehrson, C. F. Cromer*, Westinghouse Electric Corporation

9:30 a.m. Basic Sciences

53-350. A Study of the Electrical Behavior of Gases at High Pressures. *Alexander Kusko*, Massachusetts Institute of Technology

53-351. Production of Unipolar Air With Radium Isotopes. *T. L. Martin, Jr.*, University of New Mexico

53-357. Gas Tube Filament Connections. *Morris Brenner*, Burndy Engineering Company; *H. G. Schmitt*, Electrons, Inc.

53-352. Temperature Fields in Electric Coils—Numerical Solutions. *P. J. Schneider*, State University of Iowa

53-353. The Spreading and Interface Resistances of Electric Contacts. *C. W. Little, Jr., W. B. Kouwenhoven*, The Johns Hopkins University

9:30 a.m. Feedback Controls

53-354. Errors in Relay Servo Systems. *L. F. Kazda*, University of Michigan

53-355. Effects of Friction in an Optimum Relay Servomechanism. *T. M. Stout*, University of Washington

CP.* Synchronous Flux Machine. *O. J. M. Smith*, University of California

53-311. The Douglas Aircraft Differential Analyzer. *L. D. Kovach, F. M. Emerson*, Douglas Aircraft Company, Inc.

1953 Meeting in Atlantic City Establishes Attendance Record for Summer Meetings

The AIEE Summer General Meeting at the Chalfonte-Haddon Hall in Atlantic City, N. J., celebrated the 50th anniversary of the AIEE Philadelphia Section and the 2,372 members and guests established a new attendance record for this annual meeting. There were 55 technical sessions and the number of papers were arranged so that sufficient time was available after almost all the sessions for the members to enjoy the daytime activities of the seaside resort.

In keeping with the Atlantic City atmosphere, members and ladies enjoyed short ocean sails and seafood dinners. There was a bingo and card party on Monday evening; a dinner with excellent entertainment on Tuesday; on Wednesday a cabaret dance was held; and on the last evening there was a moonlight sail on the ocean.

ANNUAL MEETING

The AIEE Annual Meeting was held in the Vernon Room of Haddon Hall on Monday morning with AIEE President D. A. Quarles presiding. H. H. Henline, AIEE Secretary, summarized the Report of the Board of Directors in which it was stated that the Institute membership on May 1, 1953, was 45,426, an increase of more than 3,200 in the past year. (For complete Report of the Board of Directors, see page 721.) Mr. Henline also read a summary of AIEE Treasurer W. J. Barrett's report which showed that the Institute finances are well in the black. (See page 753.)

The report of the Committee of Tellers also was given by Mr. Henline with the following members elected: for *President*, Elgin B. Robertson; for *Vice-Presidents*, W. B. Morton, C. P. Almon, Jr., A. S. Anderson, G. C. Tenney, and G. D. Floyd; for *Directors*, D. I. Cone, T. M. Linville, and E. W. Seeger; for *Treasurer*, W. J. Barrett.

In another report from the Committee of Tellers, Mr. Henline announced that the three amendments to the Constitution had been voted on by the membership and had been adopted by a large majority.

Mr. Quarles introduced President-elect Elgin B. Robertson and presented to him the President's badge. In his reply, Mr. Robertson expressed his gratitude to the members for his election and said that he considers that the friends he has made in the Institute are priceless and that he feels well compensated for all he has done while a member. He pledged co-operation in furthering plans supported by the Institute membership.

Mr. Quarles then introduced the following men who were District Branch First Prize winners: Theron Usher, Jr., North Eastern; L. A. DiPaolo, A. J. Kane, and C. A. Quinn, Middle Eastern; Richard Farrelly, New York City; H. W. Thompson, Jr., and S. H. Wesley, Jr., Southern; R. D. Driver, Great Lakes; R. L. Richardson, North Central;

A marine sight-seeing trip, one of the many interesting activities planned for the ladies attending the Summer General Meeting, sets out from Atlantic City

H. W. Rose, South West; and Dayne Hansen, North West.

Major E. H. Armstrong was introduced by Mr. Quarles and presented with a certificate of honorary membership in the Institute. After thanking the members for the honor, Major Armstrong presented his address, "The Spirit of Discovery—A Tribute to the Work of Marconi." (See page 670.)

In an address prefacing the presentation of the Lamme Medal, L. L. Bosch, chairman of the Lamme Medal Committee, gave a short history of the medal's establishment. He was followed by AIEE Past President E. S. Lee, who recounted the career of the medalist, I. F. Kinnard, who was then presented the Lamme medal by Mr. Quarles. Mr. Kinnard's response, "Truth and Measurement," dealt with the importance of exact measurements in all engineering work. (*See EE, July '53, pp 578–83.*)

The final address of the program was "Progress and Problems" by Mr. Quarles, the full text of which is on pages 667–9.

COMMITTEE

The members of the 1953 Summer General Meeting Committee were: L. R. Gaty, general chairman; B. L. England, W. F. Henn, vice-chairmen; R. W. Wilbraham, treasurer; A. C. Muir, Institute Director; R. M. Pfalzgraff, D. B. Smith, members-at-large; J. C. Strasbourger, Vice-President, District 2; W. F. Denkhaus, arrangements; J. B. Harris, Jr., entertainment; R. W. Wilbraham, finance; H. F. Davis, hotels; Mrs. H. R. Paxson, ladies; M. L. Stoughton, publicity; T. E. Stieber, registration; A. D. Brown, sports; Arthur Pringle, II, inspection trips and science theater; S. R. Warren, students; W. R. Clark, technical program; W. G. Salmonson, transportation.

New Ideas and Operational Procedures Freely Exchanged as Section Delegates Confer

The chairmen of important Institute general committees and the Section delegates freely exchanged new ideas on operational procedures in an all-day conference held in Atlantic City on June 16. In the morning session with Director A. C. Muir presiding, the work of the Committees on Registration of Engineers, Membership, Transfers, Board of Examiners, and Student Branches was outlined by the respective chairmen. In the afternoon session with C. S. Purnell, chairman of the Sections Committee, presiding, the topics of changes in Section organization, Institute affairs, Section organization and management were discussed and a general discussion by the delegates took place. The conference was opened by Mr. Purnell who extended a warm welcome to the delegates and advised that this was their meeting with an opportunity to ask questions and exchange ideas of profitable and interesting experiences.

REGISTRATION OF ENGINEERS

The importance of this subject was stressed and the aims of the Committee on Registration of Engineers were outlined by Newell L. Freeman, chairman of the committee and secretary of the New York State Board of Examiners.

As to the importance of professional registration, Mr. Freeman explained that licensure or registration in a learned profession is for the protection of the public. The public reserves the exclusive right to practice in this field to those who meet the statutory requirements and licensed professional engineers are given a preferred position in the courts. In return, the public expects competence and protection from bungling and extortion.

Regarding qualification requirements for professional registration, the speaker listed these as seven: age, character, citizenship, high school, college, internship, and examinations. With respect to age, citizenship, and high school, the law can be very specific; but the other qualifications must be determined by someone's personal judgment, and this is done by the Board of Engineering Examiners. Good moral character is essential for often a fiduciary relationship exists between the engineer and his client and integrity is considered the keystone of the profession.

To bring the importance of professional registration to the members, the committee has the following plans: It is proposed to continue the occasional articles on registration of engineers in *Electrical Engineering* and to continue the identification in the "Year Book" of each member who is licensed or registered as a professional engineer. Literature will be made available at headquarters. A nation-wide list of speakers who are competent to speak on the subject of registration and who can advise properly both at the Section level and in the Student Branches is in the making. In conclusion, Chairman Newman asked the delegates to give registration some thought when preparing Section and Branch meeting programs for the coming year.

In discussion, Vice-President E. S. Lammers, Jr., inquired as to how soon students can become licensed. Mr. Freeman explained that not more than one or two states grant a license without experience and that in New York State a period of 4 years' internship is required. The written examination is in three parts and two parts can be taken immediately upon graduation. Those who take the examinations early do much better. A. C. Muir cited the advantage of the status of engineering training which permits association with experienced engineers.

MEMBERSHIP

The trends in membership growth and the decrease in the number of enrolled students were cited by Charles Clos, chairman of the Membership Committee. As of April 30, the membership reached a new high of 45,426 members, an increase during the year of 3,206 members or the fourth largest numerical gain on record. This is a gain of 7.6 per cent, a decrease from last year's high of 10.9 per cent. During the year, 4,019 applications were received of which 1,614 were from students. Student applications last year were 2,591 and for the year previous 4,168, and the decrease is expected to continue for another year or two.

Students in the Branches are followed up on graduation by having them fill in postal cards which are sent to headquarters; these in turn are forwarded to the Sections where the graduates will take up their employment. Mr. Clos urged that the Sections begin membership work early, as last year 30 per cent of the Sections did not have their membership committee chairmen appointed by September 15. Also, only about 30 per cent of the postcards were sent in last year. The decrease in student enrollment from a high of 20,000 to 6,782 for the past year left an area for improvement. On the bright side, the Institute had more members with fewer in dues arrears.

Chairman Clos said that the Membership Committee at its January meeting decided to abandon the use of the return reply prospective cards because statistics have shown that when these cards were in use, fewer new membership applications were received and the local membership committees did not follow through on the matter. In place of the cards, the committee has instituted a "Membership Month" in the fall of the

Section delegates hold an all-day conference on Tuesday during the Summer Meeting

year in all the Sections, and it would like to see every Section membership chairman appointed by September 15, as well as chairmen of the Transfers and other committees.

TRANSFERS

In the absence of C. D. Carpenter, chairman of the Transfers Committee, the importance of the work was explained by E. P. Yerkes, the incoming chairman. He said that according to the Constitution the advancement of the profession means not only the advancement of the organization, but each member in the highest grade for which he is qualified. The national Transfers Committee is anxious to be as helpful as possible but the initiative must start with the Sections themselves. It was further explained that to act on applications for transfers takes a fair amount of time and that one of the main elements of the time required is to hear from references so that the earlier the transfers committees can get started, the better the results. To assist in the work, a proposed transfers guide which had been prepared was distributed to all Section delegates. The draft of the guide should be considered as tentative until approved by the Board of Directors when it will be distributed in permanent form. The guide sets forth the various membership requirements for each of the corporate and noncorporate member grades and it sets forth the routines for the local transfers committees as well as for the Board of Examiners and the Institute's Committee on Transfers.

BOARD OF EXAMINERS

The work of the Board of Examiners was reviewed by C. W. Franklin, chairman. The prime function of the board is to make recommendations to the Board of Directors on applications which are in process. The membership of the Board of Examiners is comprised of people who can come to New York once a month and who are no farther west than Pittsburgh, Pa. The work starts at 1:30 p.m. and usually is finished by 5:00 or 6:00 o'clock. The work is classified by headquarters so that the boards can consider enrolled Students, the Affiliate grade, and the Associate grade in groups.

The speed of acting on applications depends upon how completely the forms are filled in with respect to all of the constitutional requirements. Mr. Franklin explained that many applications are received which merely state, for example, "chief engineer in 1935." The chairman emphasized that all sponsors should be certain that full information is given so that the board can act intelligently on that information.

With respect to the Fellow grade, Mr. Franklin called attention to the new constitutional requirements and emphasized the point that the applicant must have "attained distinction." Sponsors should indicate on the application what that distinction is and the application will go through much easier.

Many cases have taken months before they can be acted upon due to incomplete information on the applications, lack of references, and so forth. In regard to the grade of Associate Member for recent college graduates, the curriculum of the applicant's school must be approved; the Board of Directors considers the schools which have been accredited by Engineers' Council for Professional Development (ECPD) as approved curricula. If the curriculum is not approved the board will consider the status of the applicant as an engineer in training and one who is not a professional engineer.

Attention was drawn by the speaker to the section of the June issue of *Electrical Engineering*, "AIEE Fellows Elected," pages 560–3, which if read and applied to prospective members in the Sections for the Fellow grade should give sponsors a pretty good idea in regard to eligibility.

In discussing the Affiliate grade, Mr. Franklin pointed out that one or two Sections feel that the requirements are a little too broad and that the applicant should be at least in the electrical industry. The board probably would approve an applicant for this grade who is an electrical draftsman, but when considering an applicant who is a tree expert, the speaker said that he would not like to predict the board's action.

In conclusion, the speaker stated that the local transfer committees feel that they should be notified by the board in the cases of rejected applications but that he feels that this is a personal matter about which the board should notify only the applicant directly.

Discussion. A letter of April 6, 1953, from R. R. O'Connor, chairman of the Chicago Section, was read by Director A. C. Muir, which stated that Mr. O'Connor's views on the need to notify local committees in cases of rejection had been correctly recorded in the minutes of the January meeting. Knowledge of a rejection on the part of a good membership committee chairman would pave the way for a few appropriate words of regret and thereby leave the potential applicant in a better frame of mind. In some cases, it might be possible to suggest ways in which the applicant possibly might qualify for a particular grade of membership and the way in which the present procedure is conducted could be greatly improved. Considerable discussion took place and a number of the delegates concurred in these views.

The conference unanimously passed a motion which requests that the Board of Directors review the present procedure for the handling of membership and transfer applications which are directed through the Sections and it was the feeling of the conference that the Section, Membership, and Transfer Committees should be more fully informed of the action taken on applications, particularly those which are rejected.

In response to a question raised, Charles Clos, chairman of the Membership Committee, pointed out some serious pitfalls to the aforesaid motion. Every application has references which are supposed to be kept confidential. The motion involves a matter of changing the entire system and Mr. Clos believes that strict rules make for a better membership in the long run. If the local transfer committees were notified, it would be necessary also to notify the sponsors or references and the Board of Examiners considers that the reports of references should be kept inviolate.

In a further discussion on membership, the question was raised as to whether, in view of the constitutional changes, if an Associate had resigned some time ago in good standing, he would be reinstated as an Associate or an Affiliate. Mr. Franklin said that if the resignation was in good order, the board would be inclined to look favorably on the reinstatement, particularly if added experience further qualified the man. If there was doubt about the matter, he suggested that reinstatement as an Affiliate would be a way out of the difficulties for the local committees.

In response to the question as to what would happen in the case of a displaced person who had completely lost all of his records, Mr. Franklin explained that if he had been in the United States for a period of time and if the references would indicate that they had known him for some time, the board would be inclined to accept his application. However, if the period of time was short, for example, 6 months, they would be likely to look at the matter suspiciously.

The chairman delegate of the Central Indiana Section, G. R. Guthrie, raised the question as to whether there was not a change in the step for a student to become an Associate Member and he advised that many students were being lost from Rose Polytechnic Institute and Purdue University. The card system is helpful but not entirely successful because the cards come out when the Sections are undergoing reorganization at the beginning of the year. Secretary H. H. Henline advised the conference that they had overlooked parts of the present procedure and that on May 1 applications are sent to the graduating students before they leave school and many hundreds of applications are received. Headquarters has a record of every enrolled Student member. Director Victor Siegfried remarked that there is an advantage in having the student memberships carry over for a period of time at the $5.00 fee. J. J. Anderson of the headquarters staff cited cases as examples where the automatic transfer from enrolled Student to the grade of Associate would be inadvisable.

In connection with the transfers of enrolled Students, five points were suggested for study by the Committee on Student Branches and report to the Board of Directors but the motion was not carried. B. Cozzens of Los Angeles, Calif., stated that the matter of the engineer in training is not one which should be referred to the Committee on Student Branches as it has no direct relation to the Student Branches whatsoever, but it is something which should be given consideration by the conference.

STUDENT BRANCHES

The functions, organization, operation, and specific activities of the Committee on Student Branches, particularly as related to Section activities, were outlined by Professor F. W. Tatum, chairman of the committee. In considering the establishment of new Student Branches, Professor Tatum pointed out that they must be in schools where the curriculum is accredited by ECPD and that the committee has approved the following schools for Branches: Laval University, Saint Louis University, and the University of Dayton. Only three schools with accredited electrical engineering curricula remain eligible for the establishment of future Student Branches, namely, University of California at Los Angeles,

Dartmouth, and the United States Naval Postgraduate School at Monterey, Calif.

Associate Membership. Requirements for this grade of membership were covered in detail in the article, "A Redefinition of AIEE Membership Grades," by C. W. Franklin (*EE, Apr '53, pp 281–4*). Professor Tatum added that a person is not eligible for Associate Membership unless he is a graduate of an ECPD accredited curriculum, not necessarily electrical. After a grace period to November 1, 1955, Branches without an accredited electrical engineering curriculum will go out of existence.

Certificates of Branch Authorization. In accordance with the suggestion of Professor E. R. Welch, certificates of Student Branch authorization signed by the District Vice-Presidents will be issued to all branches at ECPD accredited schools.

Joint AIEE-IRE Activities. Professor Tatum reported that a joint AIEE–Institute of Radio Engineers (IRE) Student Branch Co-ordination Committee has recommended to the Committee on Student Branches and to the IRE Committee on Education that joint branches should sponsor a joint Student Prize Paper Contest. Both AIEE and IRE Student members would be eligible and a joint AIEE-IRE certificate should be awarded to the winner. The proposal provides that both parent organizations should contribute an equal share of the prize money and an IRE student member who wins the branch competition should be allowed to participate in the AIEE District Branch Competition upon application for AIEE Student membership. Joint competitions for larger areas or geographical areas corresponding roughly to the Districts are anticipated and it also is planned to encourage Section-sponsored competitions on a joint basis. A showing of hands indicated that about 30 Sections now are sponsoring Student Paper Contests and 10 of these Sections are limiting the contest to AIEE Student members.

Interests of Branches. From an analysis of the reports of Branch meetings, Professor Tatum advised that the Student Branches are interested in curricula changes, teacher evaluation, and guidance. The latter subject is one which offers the possibility of Section-Branch co-operation. In conclusion, Professor Tatum suggested that the Sections' executive committees should include the Branch counsellor and the Student Branch chairmen in their Sections.

INSTITUTE AFFAIRS

"*This Is Your Institute.*" An illustrated lecture in preliminary form, "This Is Your Institute," was given by Assistant Secretary Nelson S. Hibshman. The lecture visually emphasizes and highlights the report of the Board of Directors. All of the important activities, Sections, Branches, membership, meetings and conferences, technical operations, publications, Standards, and research, were covered including photographs of several of the general committees in action as well as headquarters' facilities and members of the staff.

Mr. Hibshman explained that the lecture was in rough draft form and suggested that the delegates take back with them the visual story; he said that slides will be available in time for the first Section meetings in September if desired, as well as a copy of the mimeographed talk to go with the slides.

AIEE Re-Districting. A preliminary plan and map for the geographical re-Districting of the AIEE was presented by Vice-President M. D. Hooven. Due to the rapid growth of the Institute, the Board of Directors first saw this problem when it became impossible for the President to visit the various Sections; with continued growth it now has become a difficult, if not impossible, task for the Vice-Presidents to visit all the Sections in their Districts. The Board of Directors suggested that the Planning and Co-ordination Committee look into the matter; and a subcommittee consisting of M. D. Hooven, chairman, J. R. North, and K. B. McEachron, was appointed.

In a study of the problem, it appeared desirable to keep the number of Vice-Presidents on the Board of Directors about the same as at present.

In the re-Districting, Mr. Hooven explained that the setup was on the basis of the work load that the Vice-Presidents can carry and consideration was given to towns where two Sections per day could be visited. The combination of foreign and New York City formerly comprising District 3 has been abolished and a new District 3 established from portions of the territory formerly in Districts 2, 4, and 5. In the proposed plan, the number of members varies from approximately 1,500 to 10,000 members per District. In the plan, no thought has been given to conform to the IRE system of districting.

In conclusion, Mr. Hooven stated that those who would be most interested are the people whose boundaries have been changed. Copies of the proposed map were distributed to the delegates who were requested to study it and submit any ideas.

CHANGES IN SECTION TERRITORY

On receipt of a petition by Vice-President J. C. Strasbourger, the conference recommended to the Board of Directors and the Board subsequently approved the establishment of the 99th Section to be known as the Susquehanna Section. This was formerly the Lancaster-York Subsection of the Maryland Section.

CHANGES IN BYLAWS

The chairman of the Sections Committee, C. S. Purnell, read to the conference the changes in the Bylaws which redefine the scope of the Sections Committee more clearly and establish the basic relationship between the committee and the Sections.

SECTION ORGANIZATION AND MANAGEMENT

Section Activities Booklet. Dickson Lewis, chairman of the Subcommittee to Revise the Section Activities Booklet, reported that he had a very active subcommittee to bring the pamphlet up to date to include a number of activities which have originated since 1947. He said that he would be glad to entertain any suggestions for the next edition and expressed hope that all of the Sections would find the booklet useful.

Section Growth Awards. Commenting on the plan for Section Growth Awards, V. L. Ingersoll, chairman of the subcommittee, suggested that the delegates should not presume that the present formula is the ultimate answer but that it is the best that has been developed so far. The plan is based on both membership growth and attendance at meetings and the averages over the past 3 years are compared with the attainments of the current year. The plan now has been effective for a sufficient period of time so that the awards now made are up to date.

First prize for Section growth in the class of larger-than-average Sections was awarded to the Schenectady Section. Second prize in this class was awarded to the Maryland Section.

First prize in the class of smaller-than-average Sections was awarded to the Spokane Section. Second prize in this class was awarded to the Cincinnati Section.

The Section Growth Award plan was announced in an article by Past Vice-President C. G. Veinott (*EE, Sept '51, p 757*), and also is given in the "Section Activities" booklet.

GENERAL DISCUSSION BY DELEGATES

Delegates from the Philadelphia, Illinois Valley, Cleveland, Maryland, New York, and Detroit Sections all reported successful meetings with better attendance on a technical group basis. The New York Section reported good success with the round-table type of conference with three such conferences running concurrently on the same evening.

Prize Paper Competition. E. C. Wentz of the Sharon Section reported the successful stimulation and production of papers without the award of prizes. Authors are recognized by the duplication of all papers which are sent to the members with a ballot and a notice of the Section meeting and in this way interest is attracted. The chairman delegate of the Lynn Section, E. K. Rohr, advised that their competition was limited to the younger engineers under 30 years of age. The winners enter a tri-Sectional competition between the Pittsfield, Lynn, and Schenectady Sections. C. C. Herskind, chairman of the Schenectady Section, reported that they had 35 entries for the tri-Sectional competition. In summarizing the matter, Chairman Purnell said that the reports of the delegates indicated a variety of ways of conducting prize paper competitions and he urged that continued study of the methods should be made and that other Sections should try them out.

Steps in the Formation of Subsections. C. R. Vail of the North Carolina Section reported on activities centering about Raleigh through correspondence. Meetings were organized with an average attendance of 35 people and there has been considerable new growth in membership in that part of the state. He inquired as to how an Eastern North Carolina Subsection could be formed, as now one Section embraces the entire state. The vice-chairman of the San Francisco Section, W. A. Howe, reported that the Honolulu Subsection will attempt to attain Section status. The Subsection has grown from 40 to 50 members 3 years ago to 97 to 100, and such a petition soon will be forthcoming.

The delegate from the Arizona Section, K. V. Fletcher, inquired as to how speakers can be furnished for meetings at Tucson. The programs for the Phoenix meetings will be technical and they are held on Saturdays

as the state organization meets at that time.

With regard to the possibilities of a Subsection in East St. Louis where there are basic industries on the east side of the river, R. W. Schoetker, delegate from St. Louis, inquired as to how close to the main Section a Subsection may be formed. Chairman Purnell replied that he did not believe that there are any restrictions in this respect.

Publicity. The chairman of the Public Relations Committee, G. T. Minasian, advised that the basic policy of the committee and Raymond C. Mayer Associates is to be of service without attempting in any way to direct the Institute's activities. In the matter of assistance, he referred to the publicity kit which is sent to the chairmen of all Sections and Subsections, the publicity newsletter which is a source of exchange of information, and the publicity manual for meetings. In conclusion, Mr. Minasian said that the delegates should not hesitate in calling on Raymond C. Mayer for any assistance and they were invited to visit the press room. William Ferris will be the chairman of the Public Relations Committee during the next year.

The chairman of the Philadelphia Section, W. F. Denkhaus, told of a very successful program which his Section has been broadcasting for 1/2-hour periods since April 1 which deals with such topics as the history of engineering; engineering education; the engineer enters industry; and engineers in electric power, in the Delaware Valley, in industry, and in construction. The broadcasts were discontinued in June and will be resumed in September. The station donates the time and the Section pays $10 a broadcast for the recording.

R. W. Tapy of the Northern New Mexico Section, C. A. Wells of the Los Angeles Section, and D. P. Hutchinson of the Wichita Section all reported good results which had been obtained with joint publicity. J. P. Quitter of the Cincinnati Section advised that the local papers were very much interested in the achievements of local members elsewhere and that it pays to invite the newspapermen to dinner once in a while.

Section Finances. In introducing this subject, Chairman Purnell stated that he knew that it was a difficult job to keep within the allotments with increasing expenses and he expressed hope that the Sections could continue to keep within their allotments for a long time to come.

R. W. Jones of the Chicago Section reported that their publicity committee had made a canvass in respect to those to receive notices during the year and that only half of the members would receive notices in addition to the annual meeting. Records would be kept and the results would be compared.

D. A. Riechel reported that the Portland Section had made $600–700 by sponsoring educational courses with 74 registered for the courses.

R. W. Sherwood of the Belmont Section inquired with respect to the financing of a Subsection and the retaining of the full allotment. George Bower suggested that the Subsections be required to prepare and submit a budget.

Increasing Meeting Attendance. The delegates of the Cincinnati, New York, Mexico, Des Moines, Kansas City, and Binghamton Sections all reported ways in which the attendance was effectively increased by social hours, refreshments, telephoning, weekly bulletins, use of the monthly notice as posters, and by writing directly to husbands and wives.

Left to right: Elgin B. Robertson, newly elected President of the AIEE, and outgoing President D. A. Quarles congratulate I. F. Kinnard upon receipt of the 1952 Lamme Medal. L. R. Gaty, general chairman of the meeting, is at far right

Student Guidance. The delegate of the Ridgway Section reported on the successful establishment of a scholarship intended to stimulate high school students to enter the field of engineering. The program comprises the introduction of leading engineers to the schools once a year, and the number of applicants for the scholarship examination has increased from 7 to 50. The school principals helped to eliminate some of the candidates and the boys eliminate themselves. The program is supported financially by industries. Chairman Purnell added that a number of women's auxiliaries had been established with growing success and that the Philadelphia women have also provided a scholarship.

Special Technical Conferences. Vice-Chairman of the Committee on Technical Operations, J. D. Tebo, pointed out that the special technical conferences which are sponsored jointly by a technical committee and a Section were very successful and that 16 had been held in various sections of the country during the past year. The technical committee depends upon the Sections to appoint members to serve on the committee and the Section looks after the hotel arrangements, publicity, and so forth.

Co-operation With Student Branches. The chairman delegate of the New York Section, L. F. Stone, reported that there are ten colleges in the New York City area and that the ten counsellors meet and elect a chairman. Two annual affairs are held for students, one of which is a fall dinner where the counsellors and the chairmen of the Branches get together. The other affair is the Student Prize Paper Competition which is held in May with the prize paper contest in the morning followed by a luncheon and a feature lecture in the afternoon which is usually attended by more than 200 students.

Recognition of Past Section Chairmen. The establishment of pins as recognition for past Section chairmen was referred to by Chairman Purnell, who suggested that there is enough interest in a certificate or scroll which could be framed and hung up on the wall. The appointment of a subcommittee to design a certificate and send it to the Secretary for an opinion was suggested.

REMARKS BY PRESIDENTS

In addressing the Section delegates conference, President Quarles said, "Every time I attend this meeting I have a feeling we are really getting down to the pulse of the Institute." Those who have served on the Board of Directors and the committees, know that one must get the feeling or sense of the membership in order to pass on certain matters. When considering the views of other professional societies, particularly in relation to the unity of the profession, it is very important to know the thinking of the members. With regard to the announced IRE policy to the effect that the society does not speak for its members on technical matters, President Quarles pointed out that this is quite different from what the AIEE membership wanted as indicated from our polls and other expressions. There is also a limit beyond which the members would not like to see the Institute go, and in between is a rather fine line of demarkation. In conclusion, Mr. Quarles urged the delegates to think about the matter and to develop a grass roots policy and follow through. The delegates were asked to give careful thought to this important matter and then to study the views in local areas and other professional bodies and to be vocal about their thoughts in these matters.

President-elect Elgin B. Robertson remarked that he was about to say the same thing in a different way. He advised that in some organizations the national secretary and the president pretty much operate the organization. The Institute does not operate in that way and the Board of Directors holds five meetings a year. There is an honest feeling on the part of the members of the board that they are conducting the business in accordance with the views of the membership and the way in which the problem of rezoning is being handled serves as a good illustration.

Mr. Robertson stated that if a way could be found to improve the means of communication between the members and the board, affairs could be conducted more according to the members' desires. In conclusion, he stated that the members of the board are a much maligned group of men, and that if anyone has an idea that affairs are not conducted properly, he can

come to him and Mr. Robertson will guarantee his appointment to a committee.

REMARKS BY NEXT YEAR'S CHAIRMAN

As the meeting concluded, W. R. Hough, chairman of the Sections Committee for the coming year, spoke briefly to the delegates. He said that he had seen evidence of a strong healthy condition and that the Sections Committee is considered to be the heart of the Sections. It was difficult, he said, to find a really soft spot in the program, but Mr. Howe referred to the greatly decreased Student enrollment in the Branches. He suggested that the delegates look toward ways and means of improving this condition at the grass roots level. He stated that John Fuller of the Cleveland Section has been elected secretary of the Sections Committee for the next year and that the job of that committee will be to help the Sections.

Technical Sessions at Summer Meeting Present Wide Range of Subject Matter

Covering subject matter ranging through the entire gamut of Institute activities, a total of 55 technical sessions and conferences were held during the 5 days of the Summer General Meeting.

FACSIMILE

Four papers were presented on facsimile at a session on Monday afternoon over which E. C. Chamberlin, Western Union Telegraph Company, presided.

There was one technical paper, "A Level Compensator for Telephotograph Systems," presented by T. A. Jones and W. A. Phelps, both of Bell Telephone Laboratories, the other three being conference papers. Mr. Jones, who read the paper, first described the broad-band type-*K* carrier system and the type-*L* carrier system which is used on coaxial cables, and the nature of the interference to which these types are subject. He then described the level compensator which is added to the telephone channel to reduce the interference effects when photographs are transmitted.

The first of the three conference papers, "The Transmission of X-Ray Films by Facsimile," was given by K. R. McConnell, Times Facsimile Corporation, in which he described the means whereby an X-ray negative is scanned so that one facsimile recording will show all density shadings. This improved circuit automatically adjusts the brightness of the exciter lamp as the density of the original copy varies during the scanning period.

"The Facsimile Transmission of News and News Photographs for Television," by J. V. L. Hogan, Hogan Laboratories, Inc., and Dewey Frezzolini, International News Photos, was read by the former. This apparatus is a direct recording machine which can be set up in a television studio before the camera, and as the photograph or news is printed on the newly developed moist paper in a standard recorder, it is put directly on the air. The 1,050 scanned lines of an 8- by 10-inch picture provides all the necessary detail required for 525-line television scanning.

"A Discussion of Communication Synchronizing Systems" was presented by F. T. Turner, Western Union Telegraph Company. The system is one capable of maintaining a high order of synchronism between the transmitter and receiver. The receiving system is a form of stabilizing servomechanism applied to the synchronized device and the required accuracy of synchronization lead to an expression for the loop gain of the servo system and to the value of noise which can be tolerated within the bandwidth.

STORAGE BATTERIES

On Monday afternoon, an important session on storage batteries was held, presided over by H. C. Riggs, Electric Storage Battery Company. A feature of the meeting was a paper by E. N. Craig and W. J. Hamer, National Bureau of Standards, on "Some Aspects of the Charge and Discharge Process of Lead Acid Storage Batteries."

Dr. Hamer, who presented the paper, stated that the addition of sulphates of magnesium and sodium is detrimental to the rate of charging of the sulphated lead-acid storage battery, and that on discharge, any apparent benefits disappear when the discharge is at a high rate, or the concentration of electrolyte is appreciable. In new batteries, such additives may prolong the discharge, but do so at the expense of the operating voltage level.

"Nickel Cadmium Batteries" was presented by Arthur Fleischer, Nickel Cadmium Corporation, who discussed the principal features of two types of these batteries, and their process of manufacture. These were the older pocket type, and the sintered-plate type, developed in Germany, which is still experimental.

E. A. Hoxie, Electric Storage Battery Company, gave a paper on "Some Discharge Characteristics of Lead Acid Batteries." After reviewing the fundamental discharge process, the reliability of specific gravity readings as an indication of the state of charge, and the effect of temperature, Mr. Hoxie presented a formula which provides an indication of the capacity of a cell for any duty cycle.

"Maintenance of Storage Batteries on the Philadelphia Electric Company System" was presented by P. B. Wickersham of that company. Acceptance tests, maintenance, operating procedure, safety equipment, and precautions were described.

ELECTRICAL TECHNIQUES IN MEDICINE

Two measuring instruments and a method for measuring materials at ultrahigh frequencies were described in three conference papers in the session on electrical techniques in medicine and biology over which S. R. Warren, Jr., University of Pennsylvania, presided.

S. R. Gilford and S. Saito, National Bureau of Standards, described a hand-operated electrostatic type of generator for use in a portable radiation detector. Employing a reciprocating drive, 2 kv at 50 cycles can be generated.

"An Electronic Flowmeter" by H. P. Kalmus, National Bureau of Standards, described a means for measuring the flow of molten metals down to a velocity of 1 centimeter per second with an accuracy of 2 per cent.

H. P. Schwan and Kam Li, University of Pennsylvania, presented the third conference paper, "Measurements of Materials With High Dielectric Constant and Conductivity at High Frequencies." Their work has been centered on biological samples using frequencies between 100 and 1,000 megacycles.

Dr. Schwan reviewed the technical paper re-presented for discussion, "Heating of Fat-Muscle Layers by Electromagnetic and Ultrasonic Diathermy," written by himself, R. L. Carstensen, and Kam Li.

TELEVISION

The Tuesday morning session on television was opened by Dr. E. W. Engstrom, RCA Laboratories, who said that the present limitation of 12 channels in the very-high-frequency band has required the extension of the television band to ultrahigh frequency. Two systems of transmission in this band were presented, followed by a review of television standards abroad, theater television developments, and a description of a tricolor tube.

E. A. Laport and C. W. Slaybaugh, RCA International Organization, emphasized the importance of developing adequate standards if international television is to become a reality, in their paper, "A Review of

AIEE President D. A. Quarles (left) and President-elect Elgin B. Robertson (right) with Professor E. H. Armstrong, a featured speaker at the opening session of the Summer General Meeting

Television Abroad." A comparison of all extant systems was presented, and the difficulties of providing adequate quality pictures in countries where variations of as much as 10 per cent of the power frequency were common were enumerated.

A commercial version of the color tube invented by Dr. E. O. Lawrence was described in a paper entitled "The Chromatron, A Single or Multigun Tricolor Cathode-Ray Tube," by R. Dressler, Chromatic Television. The tube utilizes phosphors having long persistence, thus reducing the flicker problem found in field-sequential systems; however the red phosphor does not, at present, have the saturation provided by red filters.

"An Ultrahigh-Frequency Transmitter Employing a Klystron Power Amplifier" was presented by W. H. Sayer, Jr., Allen B. Du Mont Laboratories. A 5-kw transmitter, using cascade Klystron amplifiers for both aural and visual signals, and operating at 730 megacycles with a bandwidth of 11½ megacycles, was described.

A 1-kw ultrahigh-frequency transmitter, operating in the band 470 to 890 megacycles, was described by E. M. Bradburd, Federal Telecommunication Laboratories, Inc., in his paper, "Technical Characteristics of Federal Telecommunication Laboratories Type Number *20-B* Ultrahigh-Frequency Television Transmitter."

"Engineering Plans for Theater Television" were reviewed by A. J. Forman, *Tele-Tech* and *Electronic Industries*, who predicted that this year, the 25th anniversary of theater television, will see more than 108 theaters equipped in 56 cities and 32 states, an investment of almost $3,000,000. Of the present systems available, Telechrome sells a set capable of 1,000-line resolution, and employing the intermediate film principle; Radio Corporation of America has a projection system in use in about 75 per cent of existing installations; and the Ediphor system is available for field-sequential color projection.

BINAURAL BROADCASTING

The four conference papers on binaural broadcasting provided lively discussion in the session over which John V. L. Hogan, Hogan Laboratories, Inc., presided. Two of the speakers installed apparatus with which they demonstrated their papers.

The first paper, "Binaural Transmission by Frequency-Modulation Multiplex," was by M. G. Crosby, Crosby Laboratories. In this system, the same program is picked up by two microphones simultaneously, their output going to two channels on the same wavelength, one the main channel, the other a subcarrier supplied by a super-audible sound. Both of these are mixed, then separated at the point of reception and brought to the listener through two loudspeakers at equal volume and clarity.

R. J. Tinkham, Ampex Electric Corporation, presented "Stereophonic Recording Equipment" and demonstrated his theory with the playing of his 3-channel recordings on tape with three reproducing equipments.

"Better Realism With Binaural Sound Reproduction," by H. T. Sherman, Sherman Studios, was presented to the audience from a recording on magnetic tape. After explaining the three differences between monaural and binaural reception (the time of the sound's arrival at the ears, the loudness difference, and the difference of pressure by diffraction in a complex wave), the speaker described group listening tests which led to the conclusion that binaural sound transmission with top frequency of 3,750 cycles is equal in aesthetic quality to a monaural transmission with a top of 15,000 cycles. Sherman's paper was followed by a demonstration of his system.

Emory Cook, Cook Laboratories, presented the final paper of the session, "Engineering and Subjective Aspects of the Binaural System." This paper dealt with the theories of the placement of the microphones in the studio and the arrangement of the loudspeakers for optimum reception in the home.

Franklin Doolittle, Connecticut Broadcasting Company, in the discussion which followed, told about his binaural radio transmitter and stressed the fact that the high-fidelity fans do appreciate the efforts made.

Major E. H. Armstrong, Columbia University, said that his Alpine, N. J., transmitter is operating with multichannel broadcasting: recorded music (Musak) on one channel and a Washington, D. C., musical program on another, to see if there is interference. This station is also broadcasting short binaural programs. As to the future, he is inclined to think it may be two channels in the evening with advertising in the daytime on regular 1-channel transmission.

R. D. Darrell discussed the role of engineers, who, with their exactness, are too apt to become confused when they get into a psychological field. He feels that binaural sound should be limited to large halls and not brought into the living room. The location of a special instrument in an orchestra is not important for the complete enjoyment of music. The main factor is that the ear can hear thousands of bits per second but the human mind cannot scan quickly enough—only at the rate of 50 bits per second.

ELECTRON TUBES

The Tuesday afternoon session on electron tubes was conducted by W. C. White, General Electric Company. "Heat Transfer From Electron Tubes at High Altitudes and High Ambient Temperatures" was presented by Mrs. B. O. Buckland, General Electric Company, who used a *6AQ5* beam-power tetrode in her experiments, studying the effects of tube shielding, altitude, tube position, ambient temperature, and surrounding tubes on the temperature rise. These studies are of great importance in the design of electronic equipment to be used at the fast speeds, high altitudes, and high temperatures common with today's military aircraft.

"A Monoscope Tube for Computer and Other Appliances" was presented by John Hartmann, Allen B. Du Mont Laboratories, Inc. In this tube, an output signal is obtained which is proportional to the secondary electrons emitted from a target. A 30-line tube designed for use in a high-speed printer was described.

Byron Stokes, Sylvania Electric Products, Inc., described "A New Ultrahigh-Frequency Amplifier Tube" which can operate up to 3,000 megacycles. This tube, the *RT 469*, is expected to sell for less than $5 when commercially produced, and should speed the introduction of ultrahigh-frequency receivers.

NUCLEONICS AND POWER GENERATION

Nucleonics and power generation was the subject of an all-day combined session on Wednesday. P. N. Ross, Westinghouse Electric Corporation, conducted the morning session and J. A. Brooks, Consolidated Edison Company of New York, presided in the afternoon.

Mr. Ross, in his introductory remarks, said that electrical engineers must extend their range of interest beyond instrumentation and control to the power source if they are to take an increasing part in the development of nuclear power. As it seems doubtful that private industry could bear the full cost, the government should subsidize the development, he said. When the problems of secrecy and security can be overcome, the way should be open for full-scale exploitation of nuclear power.

To introduce the subject and indicate the probable path of its development, J. W. Landis, Atomic Energy Commission, spoke on "The Nature of Nuclear Power." By 1963 appreciable blocks of nuclear power will be in use in such high power cost areas as New England. Even now, electric energy is being produced from nuclear fission, whose cost is within a few mills of the national average, using ordinary fuels. If nuclear power is to become competitive, uranium must sell for 1 mill per kilowatt-hour. However, with our rising demand for power, and the rising cost of coal and oil, the use of nuclear energy should become more and more attractive in the future. R. L. Witzke in the morning session, and J. M. Stein in the afternoon, elaborated these points in their paper with E. U. Powell entitled, "Nuclear Reactors for Power Generation."

"The Present Feasibility of a Nuclear Power Plant" by T. G. LeClair, Commonwealth Edison Company, was presented by his colleague, W. M. Kiefer. This paper advocated the immediate construction of a full-scale nuclear power plant of the heterogeneous type, cooled by heavy water, and able to produce weapons-grade plutonium whenever necessary.

"Major Factors in the Approach to Atomic Power" by B. R. Prentice and R. G. Lorraine, General Electric Company, discussed the technical, marketing, financial, legal, and intangible aspects of the subject.

"Maintenance Problems With Reactor Auxiliaries and Instruments" was read by C. B. Wagner, General Electric Company. He described the difficulties of working on reactors, with protective clothing, time limits, disposal requirements, shielding, and corrosion posing many problems never encountered before.

J. M. Harrer and J. A. Deahong, Argonne National Laboratory, presented a paper entitled "Considerations for Discontinuous-Type Power Regulation of Nuclear Reactors," in which automatic power-level adjustment over a range of 1 to 100 per cent of full power was attained. This system of control has good stability at all levels for one fixed motor speed.

"A Simple Electrical Analogue to a Nuclear Power Plant" by M. A. Schultz and J. N. Grace, Westinghouse Electric Corporation, showed how the power and

efficiency of a nuclear-steam-turbine system could be determined easily and quickly by the use of a simple d-c circuit.

The problems of control of mechanisms in hydraulic systems, such as the coolant loop in reactors, were enumerated by W. H. Esselman and W. H. Hamilton in their paper, "Position Control in Sealed Systems," and by R. C. Robinson and W. E. McCown in "Direct Linear Motion in Sealed Systems." All the authors are with the Westinghouse Electric Corporation.

"A Photomultiplier Log Level Period Meter for Reactor Control" by V. G. Shaw, J. C. Connor, and R. G. Durnal, all of the Westinghouse Electric Corporation, was read by Mr. Durnal. The need for a logarithmic-type scale in instruments used in the control of nuclear reactions becomes apparent when it is considered that only a few micromicrowatts of power are applied to instruments when a reactor is started, increasing to hundreds of milliwatts during steady-state operation. A type-*5819* photomultiplier tube and diode log detector provide the required input circuit to the period meter.

SWITCHGEAR

The papers in this conference with R. L. Webb, chairman of the Committee on Switchgear, presiding were presented and discussed in two groups. The first group consisted of three papers on power circuit breakers and the second group was comprised of two papers on low-voltage circuit breakers.

The first paper, "Station-Type Air Blast Circuit Breakers," by K. T. Ashdown, J. A. Oppel, and G. L. Couch of the General Electric Company, was presented by Mr. Ashdown. The author described a new 14.4-kv circuit breaker and cubicle which retains the same principle of arc interruption and arrangement but features have been incorporated resulting in improvementt, such as simplified operating mechanism, consolidated control panel, balanced-type blast valve, and a streamlined air path.

The second paper, "A New 69-Kv Oil Circuit Breaker for High Interrupting Duty," by V. E. Phillips and K. G. Darrow, also of the General Electric Company, was presented by Mr. Darrow. The breaker has been designed to meet an interrupting duty of 3,500 megavolt-amperes after recognizing problems peculiar to metropolitan systems and it has successfully interrupted 5,000 megavolt-amperes on factory tests indicating that the breaker with a minimum of additional development work will be suitable for interrupting ratings of 5,000 megavolt-amperes when required.

The third paper, entitled "A 10,000-Megavolt-Ampere 138-Kv Outdoor Oil Circuit Breaker" by A. W. Hill and G. B. Cushing of the Westinghouse Electric Corporation, was presented by Mr. Cushing. He described the new oil circuit breaker which meets the extreme interrupting requirement at 138 kv and has a continuous current rating of 1,600 amperes. As the 10,000-megavolt-ampere interrupting rating is extended to lower voltage apparatus, the current interrupting ratings and short-term current ratings are increased.

The papers were discussed by well-known circuit breaker designers in competitive fields who complimented the authors and raised specific questions in regard to certain features which were answered by the authors later. In respect to the 10,000-megavolt-ampere 138-kv outdoor oil circuit breaker, E. B. Rietz of the General Electric Company commented to the effect that the paper was a good presentation of a series of tests on the performance of a breaker. He said that each time he has come to a meeting, there has been a series of papers which had a more complete story on circuit breaker performance and that it is not necessary to look across the ocean for better breakers. The question was also raised as to why users cannot come down in requirements to facilitate shipping. With reference to the station-type air blast circuit breakers, Mr. Ashdown in his closure advised concerning the blast cell arrangement that from the tests he saw no evidence of air burning whatsoever. A resistor is employed across the open breaks which is in the circuit at all times during interruption of the main arc to aid in recovery voltage.

The last two papers, which dealt with low-voltage air circuit breakers, were entitled "A New Insulated Tripping Device for Low-Voltage Air Circuit Breakers" by H. J. Lingal and M. E. Horn and "Transient Voltage and Current Requirements for Main Field Circuit Breakers for Synchronous Machines" by M. E. Horn and J. C. Cunningham. This paper was presented in two parts, the first dealing with the machine characteristics and the second with the characteristics of the breaker. Mr. Cunningham presented the machine characteristics and Mr. Horn illustrated how the assumptions and characteristics were used in the design of the circuit breaker. In response to a question, Mr. Horn advised that there were no plans to supersede the mechanical device on short time delay Navy types of breakers.

MAGNETIC RECORDING

The Wednesday morning session on magnetic recording, over which Marvin Camras, Armour Research Foundation, presided, was highlighted by the demonstration of the equipment for the reproduction of stereophonic recording developed by R. H. Ranger, Rangertone, Inc.

Mr. Ranger's technical paper, "Synchronized Magnetic Tape Recording," described the system of synchronizing sound tracks for motion pictures using an electronic lock-in instead of a mechanical one. This consists in recording on the same 1/4-inch tape not only the normal longitudinally magnetized audio-frequency record, but also a control track consisting of a transverse magnetization from the 60-cycle power driving both the tape machine and the camera at the time when the picture was made.

Three conference papers were presented at this session. The first, "The Status of Magnetic Recording," was given by R. E. Zenner, Armour Research Foundation. The other two papers dealt with recording heads. One was "Structure and Performance of Magnetic Transducer Heads" by L. L. Anderson and O. Kornei, Brush Development Company, and the second was "Performance Characteristics of Ferrite Recording Heads" by J. F. Jewett, Ferroxcube Corporation of America.

C. J. LeBel, Audio Devices, Inc., at the conclusion of the session, gave an over-all discussion of the papers. He commented on the importance of friction effects on recording tapes and stated that their handling makes the difference between good and poor recording.

TRANSISTOR STANDARDIZATION

The forum on transistor standardization on Wednesday afternoon over which R. F. Shea, General Electric Company, presided, created a great deal of discussion both during and after the presentation of the eight conference papers, which set forth various points of view.

R. M. Ryder, Bell Telephone Laboratories, opened the forum with a paper on the general scope of standardization work, which was followed by S. J. Angello, Westinghouse Electric Corporation, who told about the proposed AIEE-IRE standards on definitions and letter symbols for transistors. The three types of representation then were described: the open-circuit impedance type; the short-circuit admittance type; and the "h" parameter representation. These were given by N. T. Jones, Massachusetts Institute of Technology; L. J. Giacoletto and H. Johnson, Radio Corporation of America; and J. M. Early, Bell Laboratories, respectively.

The viewpoint of the test equipment manufacturer was presented by R. B. Holt, Transistor Products, Inc., and that of the transistor manufacturer was given by J. R. Nelson, Raytheon Manufacturing Company. A summary of the whole situation was read by R. L. Pritchard, General Electric Company.

Although the opinions expressed freely by the audience were varied, it was the consensus that these ideas received by the committee would be very valuable in the formation of standard symbols and definitions.

ELECTRICAL SAFETY

At a well-attended Thursday morning session the parts played by the various organizations interested in the safety factor of the electrical industry were explained, together with the organizations' personnel makeup, methods of procedure, and so forth. C. E. Ganther, Cleveland Electric Illuminating Company, was the meeting chairman.

W. T. Rogers, Ebasco Services, Inc., told about the work of the Edison Electric Institute, National Safety Council, and the American Society of Safety Engineers. H. H. Watson, General Electric Company, explained the safety work of the National Electrical Manufacturers Association and the AIEE. W. C. Wagner, Philadelphia Electric Company, told about the American Standards Association, Canadian Standards Association, and the United States National Bureau of Standards. The safety work of the Underwriters' Laboratories, National Fire Protection Association, and the National Board of Fire Underwriters was related by K. S. Geiges, Underwriters' Laboratories.

It was brought out in the discussion following the presentations that there is a possible danger in some of the foreign appliances being imported, as many countries are not as careful to eliminate hazardous factors as we are in the United States. There is an inter-American association interested in this phase of the matter.

Mr. Rogers told about pending bills before Congress making safety obligatory in various industries.

INSTRUMENTS AND MEASUREMENTS

Two technical and two conference papers were given in the session on instruments and measurements presided over by J. H. Miller, Weston Electrical Instrument Corporation, on Thursday afternoon. The first technical paper, "Forcing Function Generator Employing Conductive Plastic," was by L. W. Norman, Minneapolis-Honeywell Regulator Company. This generator uses a conductive plastic potentiometer to provide a forcing function signal for testing servo systems and components. It has a sine-wave output, but can be arranged to give a square-wave or triangular-wave output.

Philip Siskind, Sperry Gyroscope Company, presented the second technical paper, "A Permeability Analyzer for Magnetic-Amplifier Cores." This paper covered the design and theory of an instrument which measures the differential permeability of toroidal cores used in magnetic amplifiers. An important feature of the device is that measurements are made before wire is wound on the cores and indications can be had on either a meter or an oscilloscope.

The first of two conference papers, "Basic Theory and Experimental Verification of the A-C Galvanometer," was given by T. J. Higgins, University of Wisconsin, and William Kneen, Pullman Standard Car Manufacturing Company. This paper dealt with the theory underlying the performance of the iron-cored a-c galvanometer when used as a null detector in an a-c bridge circuit and the experimental proof of the theory.

Lewis Marzetta, National Bureau of Standards, described "An Emission Characteristic Plotter for Thermionic Cathodes." This consists of a triode for a control with its cathode connected to the plate of a diode under test, the cathode of which is connected to the negative side of the voltage source connected to the triode plate. In the plot of plate current versus plate voltage, the saturation point is raised when the temperature of the emitter is raised. This equipment can be used for finding the voltage coefficients of resistors.

WIRE COMMUNICATIONS

An all-day session was held Thursday on wire communications with E. I. Green and L. R. Montfort, both of the Bell Telephone Laboratories, presiding. The main topics were descriptions of the *L3* coaxial and the *N1* carrier systems developed by the Bell Laboratories.

"The *L3* Coaxial System" by C. H. Elmendorf, R. D. Ehrbar, R. H. Klie, and A. J. Grossman, and "*L3* Coaxial System—Amplifiers" by L. H. Morris, G. H. Lovell, and F. R. Dickinson, were read by Mr. Klie; "*L3* Coaxial System—Equalization and Regulation," by R. W. Ketchledge and T. R. Finch, and "*L3* Coaxial System—Television Terminals," by J. W. Rieke and R. S. Graham, were read by Mr. Graham.

The *L3* coaxial carrier system, a broad-band high-quality communications network, makes possible the transmission of 1,860 telephone channels, or 600 telephone channels plus a 4.2-megacycle television channel in each direction over a single pair of coaxials. Feedback amplifiers are employed at 4-mile intervals over a proposed 4,000-mile route. The signals are to be kept flat within ±1/2 decibel. To accomplish this, supplementary equalization will be provided at each 100-mile interval, additional equalization each 200-mile interval, and final equalization at each 800-mile interval.

"The Co-ordination of *M1* and *N1* Telephone Carrier Systems" by E. P. Smith, L. P. Cornell, Jr., and M. G. Jerome, Pacific Telephone and Telegraph Corporation, described the difficulties caused by the introduction of the low-energy cable-carrier *N1* system into the overlapping *K*, *J*, *M*, and *O* carrier systems. A low-pass filter with mid-point grounded has been developed to suppress interference between the *M1* and *N1* systems.

The low transmission levels used in the *N1* system make it very susceptible to noise and crosstalk between carrier systems, A. J. Aikens and C. S. Thaeler said in a paper entitled "The Control of Noise and Crosstalk on *N1* Carrier Systems." Noises are reduced by suppression at the source, suppression coils added to the system, and the proper selection of cable pairs. Crosstalk can be reduced by use of compandors, frequency frogging, and the use of masking thermal noise.

"A Miniature Compandor for General Use in Wire and Radio Communication Systems" by R. S. Caruthers and F. S. Boxall, Lenkurt Electric Company, Inc., described the development of a compact, inexpensive compandor for use in frequency-modulation, very-high-frequency, microwave, and carrier systems; it also is valuable in restoring old systems.

H. R. Huntley, American Telephone and Telegraph Company, in his paper "Transmission Design of Intertoll Telephone Trunks," discussed the changes that the introduction of automatic nation-wide toll switching will entail in the use of circuits.

As even momentary interruption of communications facilities cannot be tolerated in power systems, means must be devised to protect personnel and equipment from excessive voltages and currents. Such devices were described in the paper "Protection of Wire Communication Facilities Serving Power Stations and Substations" by T. W. Alexander, Jr., Bell Telephone Company of Pennsylvania.

TRANSFORMERS

In the first of two sessions on transformers M. F. Beavers of the General Electric Company presented a conference paper which described the techniques and discussed the results of measurement of ambient air temperature during tests on transformers. E. T. B. Gross of the Illinois Institute of Technology presented a mathematical analysis of the delta grounded transformer. The third paper, by W. D. Albright of the Westinghouse Electric Corporation, outlined the types of forced air fans and control methods that are available for the cooling of power transformers. The fourth paper, which was presented by F. C. Roeding of the Westinghouse Electric Corporation, analyzed the special 3-phase core arrangements in the light of use of the new grain-oriented steel cores which have high loss for flux crossing the oriented direction of the steel. The last paper dealt with an analytical approach to the variable-turns ratio autotransformers. The paper was written by E. Mishkin of the Hebrew Institute of Technology and the presentation was made by J. A. Adams who explained that the author's intended meaning was a variac.

In another session on transformers held on Friday afternoon, five papers were presented. The first paper, entitled "Temperature Classes for Dry-Type Transformers as Determined by Functional Tests," by Paul Narbut of the Westinghouse Electric Corporation, suggested an approach to the difficult problem of setting up industry-wide temperature limits for insulating materials currently covered by classes *A* through *H* with the possible exception of cellulose.

The second paper dealt with the life expectancy of oil-immersed insulation structures and it was prepared by W. A. Sumner, G. M. Stein, and A. M. Lockie of the Westinghouse Electric Corporation. A technique was presented for evaluating the relative effect of one or more overload cycles on life expectancy and this was applied to tests on transformers to reach certain tentative conclusions on transformer life.

The third paper, by Messrs. Poritsky, P. A. Abetti, and R. P. Jerrard, dealt with the field theory of wave propagation along coils. The paper treated the surges in air coils and core coils and transformer windings by the use of Maxwell's equations and close agreement was obtained between the calculated and experimental values. Another paper considered the propagation mechanism of impulse corona and breakdown in oil and was by T. W. Liao and J. G. Anderson of the General Electric Company. A clearer picture of the breakdown process of oil was obtained by simultaneously getting data with a high-speed camera, still camera, and photocell, as well as current-measuring devices.

In still another paper, by E. W. Tipton, sealed dry-type transformers were proved safe by test. This type of transformer without any organic material except for the semiorganic silicon varnish was overloaded to destruction and submitted to internal power arcs. By analysis of pressure and temperature measurements indications were obtained that the transformer might be operated with practically no danger from fire or explosion.

TRANSMISSION AND DISTRIBUTION

In this session with J. T. Lusignan presiding, four papers were presented.

The first paper, entitled "Physical Concepts of Corona in Capacitors," was presented by J. R. Nye of the General Electric Company, and dealt with the mechanisms of corona as influenced by the type of voltage applied to the capacitor dielectric. Correlations of the findings were made and certain laws governing the behavior of such corona were proposed and explained in terms of a physical picture which represented the dielectric as a network of elemental capacitances and resistances. The second paper, which was presented by J. H. Park of the National Bureau of Standards, developed a test method using steep-front voltage surges on pin-type porcelain distribution insulators. The objective of the study was to develop a laboratory test method to discriminate between insulators which are liable to puncture and shatter and those which satisfactorily discharge the stroke by flashover and continue to operate normally after a momentary ground has been cleared.

In a discussion on the puncture tests prepared by J. H. Hagenguth and read by Dr. Liao, the discusser considered the paper a significant contribution but raised a question as to how well it was established that puncture rather than heat and pressure caused failure. Dr. Sprague of Purdue University commented to the effect that it was gratifying that the author's test results and field experience showed good correlation. Another discussion by F. E. Andrews of the Commonwealth Edison Company stated that his experience on 34 kv bore out the findings in the paper in respect to insulator puncture and the establishment of standards was urged. C. M. Foust of the General Electric Company raised a question in regard to the time interval between the application of surges and suggested that the pin holes may have been due to a multiple stroke and a time interval very much shorter than 20 seconds should be tried.

In another paper, a field report on a new impulse test oscillograph was given by W. G. Fockler of the Allen B. Du Mont Laboratories, Inc. This oscillograph was first described at the 1950 Winter General Meeting and many refinements have been incorporated to meet the needs which have arisen in the field. The instrument has been mounted in a trailer and used in the field testing of extra-high-voltage lines at Brilliant, Ohio.

The last paper which dealt with economic merits of secondary capacitors was presented by H. G. Barnett.

On the capacitor papers considerable discussion ensued which was taken part in by J. E. Rembusch of the Commonwealth Edison Company, T. W. Dakin, F. W. Gay, C. M. Foust, and E. C. Starr. Discussion centered about the points of capacitor failure in cold weather, mechanism of failure, and connecting capacitors so that they might be switched off with the load. C. M. Foust questioned the use of d-c tests on a-c equipment and expressed reluctance to accept the results where transients were involved. E. C. Starr discussed dielectric surface space charge phenomena and flashover due to switching phenomena illustrating graphically how a charge tends to remain on the line resulting in an impressed voltage of three times normal or more. In closure, Mr. Barnett pointed out that it was impractical to use switches on overhead lines.

RADIO COMMUNICATION

A. C. Dickieson, Bell Telephone Laboratories, presided over the session devoted to radio communication at which four technical papers were presented.

The first two described the 1,000,000-watt Naval transmitter. The first, by D. G. Robertson, Radio Corporation of America, dealt with the frequency-generating equipment for this superpower very low frequency in the Pacific Northwest. The second paper, given by J. C. Walter, Radio Corporation of America, gave an over-all description of the transmitter features: the first use of electron tubes having a power gain of at least 250; 10-microsecond fault protection; a variable master oscillator with 0.001-per-cent frequency stability; and provisions for frequency-shift teletype signaling.

"Aircraft Protection From Thunderstorm Discharges to Antennas," by J. M. Bryant, University of Minnesota; M. M. Newman and J. D. Robb, both of the Lightning and Transients Research Institute, dealt with an antenna protective unit which besides protecting the radio equipment also records the by-passed current and charge magnitudes.

The final paper, presented for discussion only, was by P. F. Godley, Paul Godley Company; J. R. Neubauer, and D. R. Marsh, both of Radio Corporation of America; and described the radio installations on the New Jersey Turnpike. These consist of five very-high-frequency stations operating in the 150-megacycle range; seven 950-megacycle stations; 75 mobile units for police, maintenance, emergency service, and supervisory groups; and 86 toll booths at the 17 interchange stations.

PETROLEUM INDUSTRY

Five conference papers on electrical distribution and electric equipment in oil refineries were given on Friday morning in a session over which W. O. Mascaro, Atlantic Refining Company, presided.

V. L. Nealy, The Texas Company, discussed "Modern Electrical Distribution for an Oil Refinery." This paper, in contrast to the next one, described the electrical facilities as designed and installed at a new plant. The problems of adding new units and changing old ones in an established refinery were dealt with by W. A. Gibson, H. G. Buch, and J. F. Eisenhardt, Socony-Vacuum Oil Company, Inc.

"Industrial Turbine Selection" by J. C. Spahr, Westinghouse Electric Corporation, pointed out that while there are different factors governing the selection of turbines in different plants, there are several major objectives which should guide the selection of turbines in all plants. These are the generation of process steam and electric power at a minimum cost; an installation which will permit maximum freedom to obtain process steam and electric power as desired; and dependable operation at all times. The speaker considered each of these factors and how certain turbines should be selected to fulfill the various requirements.

The fourth conference paper, "Selecting 2,300-Volt Motor Control Equipment for the Petroleum Industry," was presented by L. T. Ellis and A. L. R. Maynard, General Electric Company. The 2,300-volt 60-cycle 3-phase motor was chosen inasmuch as this size has been found to meet the requirements of the petroleum industry in its expansion. Five different types of controls were explained and then evaluated for various operating conditions, costs, and so forth.

The final paper, "Motor Lubrication Practices in an Oil Refinery," was given by F. H. Walker and W. J. O'Meara, Atlantic Refining Company. The results are given of a 5-year test on 34 motors of sizes up to 25 horsepower, seeking to determine whether standard totally enclosed motors can operate continuously for 5 years on a single greasing. The test showed that this period was too long; however, with improvements being made in lubricants, in bearings and bearing housings, better results may be anticipated.

BASIC SCIENCE

The session on basic science was held on Friday, with M. G. Malti, Cornell University, and Walther Richter, Milwaukee consulting engineer, presiding in the morning, and H. J. Carlin, Polytechnic Institute of Brooklyn, conducting the afternoon meeting. Nonlinear problems, gas studies, and the electromagnetic field were discussed.

A review of the work on "Electron Ion Recombination at Low Pressures" was presented by Sidney Borowitz, New York University. Mr. Borowitz pointed out that the recombination process is fundamental in the theory of electric discharge in gases, since it constitutes one of the important means by which charges disappear from a discharge.

"The Electric Strength of Air in Nonuniform Fields at Radio Frequencies" by J. B. Whitehead and C. F. Miller, Johns Hopkins University, and D. L. Birx, The Franklin Institute, was presented by Mr. Birx. It was found that breakdown voltages above 2 megacycles are about 32 per cent below the corona starting voltages at 60 cycles, in a study of the frequency range from 2 to 16 megacycles. Above this frequency the voltages declined at an average rate of 120 volts per megacycle.

"Tracking Response Characteristics of the Human Operator" by J. I. Elkind gave techniques for determining the system characteristics of the human tracker when his target is complex and aperiodic.

"Acceleration Plane Method for Analysis of a Circuit With Nonlinear Inductance and Nonlinear Capacitance" was presented by Dr. Y. H. Ku, University of Pennsylvania. By plotting acceleration and velocity versus displacement curves for nonlinear differential equations, such as the van der Pol, the synchronous motor, and the combined nonlinear inductance and capacitance equations, a displacement versus time curve can be obtained which takes into account the force function at any instant.

The role that energy plays in electromagnetics is not explicitly indicated by Maxwell's equations, but is found only when the field equations are integrated over a region of space, said E. I. Hawthorne, University of Pennsylvania, in his paper, "Flow of Energy in D-C Machines." When this is done, Poynting's vector can be defined, and d-c machines analyzed by its use.

"Basic Concepts in the Analysis of Stationary Electric Circuits" by D. W. Spence, Syracuse University, and C. R. Cahn, Niagara Mohawk Power Corporation, was presented by Mr. Spence. The paper reviewed the definition of the potential function, differentiated this concept from that of electromotance, and demonstrated how stationary circuits may be solved unambiguously by the use of field concepts.

"Block Diagram Solutions for Vacuum-Tube Circuits" by T. M. Stout, University of Washington, was presented by title only for discussion.

Engineering Society Secretaries Hold Meeting in Atlantic City

The annual meeting of the Council of Engineering Society Secretaries was held in Atlantic City, N. J., June 5 and 6, 1953. Representing the AIEE at the meeting were Secretary H. H. Henline and Assistant Secretary N. S. Hibshman.

During the 2-day meeting, the engineering

society secretaries discussed, among other topics, managing publications, meeting increased cost in society operation, modern office procedure, finding and developing engineering talent for industry, and miscellaneous topics concerning engineering society operation and membership.

Officers elected to take office at the close of the meeting were: President, Ernest Hartford, American Society of Mechanical Engineers; Vice-President, E. H. Roble, American Institute of Mining and Metallurgical Engineers; Secretary, M. C. Turpin, American Society of Refrigerating Engineers; Treasurer, C. S. Doerr, Engineers Club, Philadelphia, Pa.; Directors, T. J. Eas, Association of Iron and Steel Engineers, and O. Laurence Angevine, Rochester (N. Y.) Engineering Society. The terms of two directors, J. Earl Harrington, Western Society of Engineers, and H. H. Henline, AIEE, carry over.

AIEE to Participate in 1953 ISA Meeting

The AIEE will participate as a co-operating society in the 1953 Conference and Exhibit of the Instrument Society of America (ISA) to be held at the Hotel Sherman, Chicago, Ill., September 21–25. The Institute will sponsor two technical sessions, as well as an exhibit booth for the display of the various Institute publications. Responsibility for the program has been assumed by the AIEE Committee on Instruments and Measurements through its Subcommittee on ISA Co-operation. Local arrangements are being made by the AIEE Chicago Section.

Some 15,000 persons are expected to attend the conference and exhibit. No registration fee will be charged to members of AIEE and the other co-operating societies.

The AIEE portion of the technical program is as follows:

Session 1

Wednesday, September 23, 2:00 p.m.

Chairman: A. J. Hornfeck, Bailey Meter Company

CP. A Chemo-Electrical Method for Controlling Furnace Atmosphere.** *W. L. Bassalmo*, Leeds and Northrup Company

CP. A Combustion Guide and Safeguard of the Gas Analyzer Type.** *J. E. McEvoy*, Bailey Meter Company

53-293.* An Automatic Transfer Function Measuring and Recording System. *R. J. Ehret, E. F. Hochschild, J. M. Embree, E. C. Grogan*, Minneapolis-Honeywell Regulator Company, Brown Instruments Division

CP. New Techniques in Data Reduction.** *B. S. Benson*, The Benson-Lehner Corporation

Session 2. Electronic Instruments

Thursday, September 24, 9:30 a.m.

Chairman: W. H. Wickham, Commonwealth Edison Company

53-291.* Preliminary Development of a Magnettor Current Standard. *E. P. Felch*, Bell Telephone Laboratories, Inc.; *J. L. Potter*, Rutgers University

CP. An Electronic Flow Meter.** *H. P. Kalmus*, National Bureau of Standards

53-244.* A-C Null-Type Recorder With Balancing Amplifier Which Provides Damping and Suppresses the Quadrature Component. *A. J. Williams, Jr., J. F. Payne, Jr.*, Leeds and Northrup Company

* Number denotes AIEE *Transactions* papers. Copies may be purchased at AIEE booth or by mail from AIEE Headquarters, 33 West 39th Street, New York, N. Y., at 30 cents each to AIEE members and 60 cents each to nonmembers.

** CP denotes conference papers intended for presentation only and not available except from authors.

Further information regarding the meeting may be obtained from A. J. Hornfeck, Bailey Meter Company, Cleveland, Ohio. Mr. Hornfeck is chairman of the Subcommittee on ISA Co-operation. W. H. Wickham is chairman of the Local Arrangements Committee for this activity.

Social and Technical Activities Planned for 1953 Fall Meeting

A full week of varied activities awaits AIEE members and their wives who attend the AIEE Fall General Meeting in Kansas City, Mo., November 2–6, 1953. The AIEE Kansas City Section is planning an interesting social program in addition to the full technical program and inspection trips. Headquarters will be at the Hotel Muehlebach, which is located in the heart of the city.

The week's activities will begin with a social evening on the Sunday preceding the meeting which will provide an opportunity for those who arrive early to become acquainted. In addition, a smoker is scheduled for Tuesday evening. On Wednesday, a luncheon is scheduled with the Chamber of Commerce which should help to promote better public relations between the electrical engineers and the businessmen of the Kansas City area. A dinner-dance will be held on Wednesday evening, with entertainment and an address by an outstanding speaker. Formal dress will be optional.

Ladies attending the meeting will have a full program. A reception committee, organized by Mrs. W. B. Thompson and Mrs. R. E. Burlingame, will act as hostesses at the morning coffee hours, and shopping and sight-seeing tours will be arranged. The highlight of the week for the ladies will be a bridge luncheon at the Blue Hills Country Club. In charge of plans for the luncheon are Mrs. Joel Kesler (chairman), Mrs. William Carter (vice-chairman), Mrs. M. W. Levy, Mrs. R. M. Goar, Mrs. J. R. Miller, and Mrs. W. J. Brockhouse. On Tuesday evening, Mrs. A. C. Kirkwood will entertain with a reading of a current Broadway play. (This activity is under the chairmanship of Mrs. G. C. Bolt.) On Wednesday a city-wide tour will be followed by a luncheon. "Femininity of Yesteryear" is the title of a show to be staged for the ladies in the costume wing of the Kansas City Museum.

Kansas City has many fine homes and of special interest are the Plaza and Country Club districts developed by J. C. Nichols. A tour has been planned through the William Rockhill Nelson Gallery of Art, third largest in the country. There are also industrial areas to see, and Kansas City is a grain and livestock center. The American Royal, an international exhibit of livestock, is to be held here October 16–25, prior to the Fall Meeting.

For other recreational activities, golfers will find many fine country clubs in the vicinity. Guest tickets will be provided for those who wish to play.

Arrangements for the meeting are being made by the following members of the 1953 Fall General Meeting Committee: C. G. Roush, general chairman; Riley Woodson, vice-chairman; S. H. Pollack, secretary-treasurer; C. M. Lytle, Vice-President, District 7; J. P. Kesler, registration; William Carter, reception; L. M. Schindel, technical program; R. L. Baldwin, finance; O. L. Starcke, printing; A. C. Kirkwood, entertainment; H. E. James, inspection trips; M. J. Horney, publicity; L. L. Davis, transportation; W. P. Smith, students; Mrs. S. H. Pollack, ladies' events; J. C. Bibbs, J. E. Bartfield, O. K. Johnson, C. M. Haynes, members-at-large.

Toledo Section Elects Officers

Recently elected officers of the AIEE Toledo (Ohio) Section are shown, left to right: J. B. Cloer, Jr., chairman; S. J. Tombaugh, vice-chairman; and J. W. Cofer, secretary and treasurer

Beaumont Section Elects New Officers

R. W. Sherwood has been elected chairman of the AIEE Beaumont (Tex.) Section for the year 1953–54. Also elected to serve for the new Institute year are A. F. Briggs as vice-chairman and H. J. Sutton as secretary.

New members of the Section's Executive Committee are L. B. Cherry, Earl White, J. D. Southwell, and David Kraft.

Dayton Section Observes Its 10th Anniversary

The AIEE Dayton (Ohio) Section observed its 10th anniversary at its annual picnic held on June 3, 1953. Guest of honor was W. B. Morton, Vice-President-elect for District 2, who presented a Past Chairman's Pin to each of the past chairmen of the Dayton Section since it was organized in June 1943: L. J. Fritz, J. W. Gerhke, F. S. Himebrook, W. A. Dynes, W. A. Barden, W. R. Appleman, E. R. Herzog, J. M. Rodgers, and R. L. Dingle.

The incoming officers of the Section for the coming year were introduced by outgoing chairman L. H. Henry. The new officers are: D. D. Colter, chairman; R. W. Shoup, vice-chairman; R. H. Neal, secretary-treasurer; D. L. Henry, assistant secretary; and R. J. O'Brien, W. J. Pitcher, and S. O. Thomas, Section directors.

Chemical and Mining Sessions Set for Middle Eastern Program

Charleston, W. Va., often referred to as the "Chemical Center of the World" and appropriately termed the Magic Valley, will be host to the AIEE Middle Eastern District, September 29–October 1, 1953. In keeping with the predominance of chemicals and coal mining in the area, the emphasis of the technical program will be placed on those industries. The program also will stress the electric power industry as this is the home of the first 330-kv transmission line in the United States and the center of a large interconnected power system.

As a result of the increased demand for responsible electrical engineers and the growing dependence of industry on the engineer for management functions, two sessions will be devoted to management problems. Papers have been obtained from a number of outstanding men in their respective fields.

All phases of coal mining and handling, including a-c to d-c conversion equipment, will be covered in five sessions with approximately 20 papers being presented. Two of these sessions will be sponsored by the Eastern Mining Subcommittee with R. B. Moore presiding. There will be five sessions concerning applications and problems in the chemical industry covered by 20 papers. One session is being sponsored by the Electrothermal Subcommittee, which also plans to hold a subcommittee meeting.

Seventeen papers will be presented in four sessions covering power generation, transmission, and distribution. Additional subjects to be covered will be rail transportation and general industry applications.

INSPECTION TRIPS

The following inspection trips have been selected with the intention of supplementing the general emphasis on the coal and chemical industries:

1. Owens Illinois Glass Company. Uses the latest methods in mass production of numerous types of glass bottles.

Libby-Owens-Ford Glass Company. One of the largest producers of plate glass in the glass industry.

2. B. F. Goodrich Chemical Company. Engaged in the mass production of synthetic rubber.

3. Cannelton Coal and Coke Company. Inspection of the latest and most modern coal preparation and cleaning plants.

4. Kanawha Plant of Appalachian Electric Power Company. The newest and most modern in the Appalachian system with a capacity of two 200,000-kw units.

5. Shipboard Inspection Trip. A "fish-eye" view of the many and varied chemical industries in the area as seen from shipboard.

COMMITTEE

The members of the Middle Eastern District Meeting Committee are: R. H. Greame, general chairman; Harold Atkins, secretary; F. Leinberger, treasurer; W. Hess, publicity; Charles Stouch, arrangements; Paul Barlow, meetings and inspection trips; George Unangst, technical program; Mr. and Mrs. C. B. Talley, entertainment; E. Knight, finance; H. Lindsey, advisory; R. H. Hively, administration and co-ordination.

Virginia Technical Societies Hold Joint Meeting in Norfolk

On May 22–23, 1953, the engineering and technical societies of Virginia held their annual joint meeting at the Hotel Nansemond in Norfolk, Va. In addition to the AIEE, other participating societies were the American Institute of Architects, American Chemical Society, American Society of Civil Engineers, American Society of Heating and Ventilating Engineers, American Society of Mechanical Engineers, National Society of Professional Engineers, Institute of Radio Engineers, Engineers Club of Virginia, and the Engineers Club of Hampton Roads.

The AIEE held a dinner on Friday evening which featured an address by C. A. Scarlott, manager of technical information for the Westinghouse Electric Corporation, who discussed the "Highlights and Sidelights of Engineering."

The joint meeting was concluded on Saturday morning with a conducted tour of the Portsmouth Power Station Project, arranged through the courtesy of the Virginia Electric and Power Company.

General Subjects Announced for Annual Aircraft Conference

Plans are nearing completion for the AIEE Aircraft Electric Equipment Conference which will be held this year in Seattle, Wash., September 30, October 1–2, with headquarters at the Benjamin Franklin Hotel.

General subjects to be considered on the technical program include electric system requirements for jet transports, cooling problems in electric and electronic equipment, new methods of a-c bus protection, magnetic amplifier voltage regulators, and fuel quantity gauging.

In addition to their technical activities, members attending the conference will have the opportunity to take advantage of the many recreational facilities in the Seattle area, and also to take part in the various inspection trips which are being planned. A tentative tour has been scheduled to Boeing Airplane Company which now manufactures *B-47* Stratojets, *B-52* Stratofortresses, *C-97* Stratofreighters, and Bomarc guided missiles. Puget Sound Power and Light Company's Snoqualmie Falls hydroelectric plant, only large completely underground powerhouse in the world, will be visited, and an all-day trip on Saturday, October 3, to the United States Naval Air Station on Whidbey Island has been arranged. A special helicopter sea rescue operation will be demonstrated. Transportation to and from Whidbey Island will be by a fast United States Navy destroyer-escort vessel.

For the ladies, tours of Seattle, Puget Sound cruises, and a Penthouse theater party are being planned.

Feedback Control Systems to Be 1954 Conference Topic

The second Conference on Feedback Control Systems sponsored by the AIEE will be held April 22 and 23, 1954, in Atlantic City, N. J.

Stressing the theme "Applications of Feedback Control," technical papers will be presented to show how feedback control principles are applied in various industrial fields, and equipment used in and resulting from feedback control systems engineering will be exhibited and demonstrated at the meeting.

Industrial Electric Heating Is Subject of Detroit Conference

Industrial electric heating was the subject of a 2-day conference in Detroit, Mich., May 26–27, 1953. This conference, the first of its kind, was sponsored by the Committee on Electric Heating and the Michigan Section of the AIEE in co-operation with the Industrial Electrical Engineers Society of Detroit.

The conference was attended by approximately 400 engineers from all over the world. Some 20 papers on various phases of electric heating were given by experts in the field. Session topics included furnaces, resistance and radiation heating, induction and dielectric heating, and a fluid mapper discussion group.

It is planned to hold a similar conference on the subject of industrial heating in about 2 years.

COMMITTEE ACTIVITIES

Editor's Note: This department has been created for the convenience of the various AIEE technical committees and will include brief news reports of committee activities. Items for this department, which should be as short as possible, should be forwarded to R. S. Gardner at AIEE Headquarters, 33 West 39th Street, New York 18, N. Y.

Note. Because of the changeover in committee personnel, no items on committee activities are included in this issue.

AIEE PERSONALITIES.....

J. F. Fairman (AM '20, F '35), vice-president, Consolidated Edison Company of New York, N. Y., was awarded the honorary degree of doctor of engineering by the University of Michigan at its commencement, June 13, 1953. The citation says in part, "Native of Big Rapids, alumnus of the University of Michigan and former teacher in the Department of Electrical Engineering, eminent and respected, he has fulfilled the high promise of his academic years. His standing in his profession is attested by his election as a Fellow of the American Institute of Electrical Engineers and by his elevation to the presidency of that organization. As head of the Defense Electric Power Administration he won memorable praise for his energy, his vision, his forthrightness, and his devotion to the public interest. In recognition of his splendid accomplishment he was honored with the Interior Department's Distinguished Service Award." Mr. Fairman received his bachelor of science degree in electrical engineering in 1918 and his master of science degree in 1921. After teaching from 1922 to 1925, he joined Brooklyn (N. Y.) Edison Company as an assistant outside plant engineer. He was appointed electrical engineer in 1932, and following the merger of various predecessor companies into Consolidated Edison Company of New York, Inc., in 1936, he became electrical engineer for the system. In 1941 Mr. Fairman was appointed assistant vice-president and 4 years later was elected vice-president. He was appointed administrator of the Defense Electric Power Administration in 1951 and returned to Consolidated Edison in 1953. He has served the AIEE as vice-president representing District 3 (1944–46), director (1946–49), and president (1949–50). He has actively served on many Institute committees, including Safety Codes, General Power Applications, Electrical Machinery, Board of Examiners, Education, Technical Program, Executive, Finance, Board of Directors, and Edison Medal. He is a member of the New York State Society of Professional Engineers, National Society of Professional Engineers, Tau Beta Pi, and Sigma Xi.

R. H. Barclay (AM '14, F '28, Member for Life), engineering manager, J. G. White Engineering Corporation, New York, N. Y., has been elected vice-president in charge of engineering. Mr. Barclay has been with J. G. White since 1941. Mr. Barclay was born in St. Louis, Mo., August 10, 1887, and attended Washington University. He spent the early part of his career working for electrical companies in Missouri. Coming to New York, he joined the Brooklyn-Manhattan Transit Corporation in 1915 as assistant electrical engineer. From 1917 to 1922 Mr. Barclay was employed as chief electrical engineer for The Foundation Company, New York, N. Y., where he was responsible for the electrical engineering and electrical construction of a large number of loading plants, shipyards, and vessels. After associations with Starrett and Van Vleck, Architects, New York, N. Y., the Stone and Webster Corporation, Boston, Mass., and McClelland Barclay Art Products, Inc., New York, N. Y., he was appointed to the Federal Power Commission in 1934. Four years later, he was expert adviser to the Joint Committee on Investigation of the Tennessee Valley Authority (TVA) on matters relating to the design, construction, operation, and integration of the power generating facilities of the TVA. He joined the J. G. White Engineering Corporation in 1941 as electrical engineer in charge of the electrical engineering division. He became engineering manager in 1950. Mr. Barclay has been a member of the Board of the Engineering Societies Library (1942–48, Chairman 1946–48) and has served on Engineers' Council for Professional Development (1950–53). He has been serving on the AIEE Board of Examiners from 1943 to the present time, acting as chairman from 1946–48. At one time he served on the AIEE Marine Committee.

W. S. Brokenshire, Jr. (AM '52), assistant production engineer, Pennsylvania Power and Light Company, Allentown, has been appointed assistant superintendent of the utility's construction forces. Mr. Brokenshire joined Pennsylvania Power and Light in 1924, following his graduation from Pennsylvania State College with a bachelor of science degree in electrical engineering. During World War II he served as a special co-ordinator, dealing with the War Production Board on material procurement. In 1945 he was named assistant production engineer. Mr. Brokenshire is a member of the Pennsylvania Society of Professional Engineers.

J. F. Fairman

R. H. Barclay

R. L. Witzke (AM '37, F '51), advisory engineer, industry engineering department, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been appointed manager of the industrial atomic power section. Mr. Witzke joined Westinghouse in 1936 shortly after he received his master of science degree in electrical engineering from the State University of Iowa. He has served on the following AIEE committees: Power Generation (1946–48); Transmission and Distribution (1947–53); Liaison Representative on Standards (1951–53); Standards (1947–50); and Nucleonics (1952–53).

C. W. Minard (M '45), assistant general manager in charge of power production, distribution, and engineering, Omaha (Nebr.) Public Power District, has been appointed assistant general manager in charge of operations. **C. F. Moulton** (M '48), superintendent of power, has been named assistant general manager in charge of power production, distribution, and engineering, replacing Mr. Minard. Mr. Minard began work with the utility in 1919, and Mr. Moulton has 27 years of experience with the company.

E. R. Brucklacher (AM '52), Allis-Chalmers Manufacturing Company, Milwaukee, Wis., recently completed the company's graduate training course and has been assigned to the Switchgear Department as an application engineer.

A. M. deBellis (M '33, F '48), inside plant engineer, Consolidated Edison Company of New York, Inc., New York, has been named assistant electrical engineer. **T. D. Reimers** (M '36), planning engineer, has been advanced to inside plant engineer; **D. V. Buchanan** (AM '39, M '45), division engineer, has become planning engineer; and **J. G. Noest** (M '36, F '51), division engineer, has been named assistant inside plant engineer. Mr. deBellis is a member of the Association of Edison Illuminating Companies and the Edison Electric Institute and has served on the AIEE Committees on Automatic Stations (1937–43) and Electrical Machinery (1943–46). Mr. Reimers is a member of the American Society for Testing Materials and the Edison Electric Institute and is serving on the AIEE Committee on Transformers (1947–53). Mr. Noest is a member of the AIEE Committee on Rotating Machinery (1947–53).

Alexander Kusko (AM '43, M '51) and **W. K. Linvill** (AM '51), assistant professors of electrical engineering, Massachusetts Institute of Technology, Cambridge, have been promoted to the rank of associate professor. **E. W. Keller** (AM '44, M '51), instructor in electrical engineering, has been named an assistant professor.

R. B. Fetter (AM '48), instructor in management, School of Business, Indiana University, Bloomington, has been appointed assistant professor in the School of Industrial Management, Massachusetts Institute of Technology, Cambridge.

J. R. Kerner (AM '40), application engineer, Westinghouse Electric Corporation, Newark, N. J., has been appointed distribution apparatus manager for the Eastern District. Mr. Kerner has been associated with Westinghouse since 1923, when he joined the company's graduate student course following graduation from Blias Electrical School. He is a member of The American Society of Mechanical Engineers and is secretary of the New York Section of the AIEE.

D. C. White (AM '45), assistant professor of electrical engineering, Massachusetts Institute of Technology, Cambridge, has joined the engineering staff of Holtzer-Cabot Division of National Pneumatic Company, Inc., Boston, Mass., as a consulting engineer.

OBITUARY • • • • • •

Walter Stevenson Finlay, Jr. (AM '18, M '18, F '21, Member for Life), executive vice-president, J. G. White Engineering Corporation, New York, N. Y., died June 17, 1953. Mr. Finlay was born in Hoboken, N. J., August 18, 1882, and was graduated from Cornell University as a mechanical engineer in 1904. That year he became associated with the Interborough Rapid Transit Company, New York, N. Y., as an assistant in the power department. After several years doing research and construction work for this company, he joined the White company for about 6 months as a construction engineer in New England. In 1910–15 Mr. Finlay was occupied as an industrial engineer with E. and W. S. Finlay, New York, N. Y. He then returned to Interborough Rapid Transit and in 1917–20 served as its superintendent in charge of all power construction and design engineering. In 1920 he became vice-president of the American Water Works and Electric Corporation, New York City. He went to Pittsburgh, Pa., in 1927 as president of the West Penn Electric Company. Mr. Finlay returned to New York in 1935. He continued as president of West Penn until 1939 when he rejoined J. G. White Engineering Corporation as vice-president. He became executive vice-president in 1940. With the White concern, Mr. Finlay served in many fields over a broad range of engineering and consulting projects in the United States, the Middle and Far East. Recently he had been identified with work in Iran, China, and Indonesia. He was a consultant to the Atomic Energy Commission and in 1950 served on a review committee of experts that endorsed the selection by the commission of the area in South Carolina for the production of materials to develop a hydrogen bomb. Mr. Finlay was a director of the White company, of Overseas Consultants, Inc., the Far East–America Council of Commerce and Industry, and the China Society of America. He was a member of The American Society of Mechanical Engineers.

Benjamin Hodge Nichols (AM '23, M '32), associate professor of electrical engineering, Oregon State College, Corvallis, died May 5, 1953. Mr. Nichols was born in White Pigeon, Mich., October 20, 1897, and received his degree in mechanical engineering from Oregon State College in 1919. He was granted a masters degree in electrical engineering from the same institution in 1932. In 1919 after graduation, he joined the staff of Oregon State College as an instructor in mechanical engineering. In 1920 he joined the General Electric Company Testing Department, Schenectady, N. Y. He returned to Oregon State College in 1921 as an instructor in electrical engineering. He became an associate professor in 1939. During World War II, Mr. Nichols served with the corps of engineers, rising to the rank of colonel. At various times he was a consultant for the soil conservation service, state highway, hydroelectric, and public utilities commissions of Oregon, and for the Portland General Electric Company. He also was associated with Cornell, Howland, Hayes, and Merryfield, consulting engineers, Corvallis, on a part-time basis. Mr. Nichols was a member of Sigma Tau, Eta Kappa Nu, Society of American Military Engineers, American Society for Engineering Education, and the Oregon Society of Professional Engineers.

Patrick Henry Underwood (AM '24), superintendent of distribution and planning and consulting engineer for Houston (Tex.) Lighting and Power Company, died May 17, 1953. Mr. Underwood was born in Galveston, Tex., November 21, 1896, and received a bachelor of science degree in electrical engineering from Rice Institute in 1917 and a masters degree in physics in 1923 from the same school. From 1917 to 1921 he was employed by the General Electric Company, Schenectady, N. Y., first in the Testing Department and later in the Induction Motor Department. In 1921 he became an instructor in engineering at Rice Institute, Houston. Mr. Underwood started with Houston Lighting and Power Company in 1927.

Chilton Frazier Lee (AM '47), Kentucky chief engineer, Southern Bell Telephone and Telegraph Company, Louisville, Ky., died March 13, 1953. Mr. Lee was born in Campbellsburg, Ky., May 30, 1892, and graduated from the University of Kentucky in 1917 with a bachelor of science degree in mechanical engineering. Mr. Lee had been associated with the Southern Bell Company in various engineering capacities since graduation.

MEMBERSHIP • • •

Recommended for Transfer

The Board o E aminers at its meeting of June 18, 1953, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the Secretary of the Institute. A statement of valid reasons for such objections, signed by a member, must be furnished and will be treated as confidential.

To Grade of Member

Bixler, J. E., president, Duncan Electric Manufacturing Co., Lafayette, Ind.

Boyles, K. W., principal engineer, Southern Services, Inc., Birmingham 3, Ala.
Brown, W. C., electrical engineer, General Electric Co., Chicago, Ill.
Conger, A. C., operations chief, Bureau of Reclamation, Bismarck, N. Dak.
Davis, L. J., assistant division engineer, Public Service Co. of Northern Illinois, Northbrook, Ill.
DeWyer, G. A., electrical engineer, Reliance Electric & Engineering Co., Cleveland, Ohio
Dickey, A. W., electronics applications engineer, Western Union Telegraph Co., New York, N. Y.
Erdman, H., electronic engineer, U. S. Air Force, Wright-Patterson Air Force Base, Ohio
Gamble, M. E., application engineer, Robert O. Whitesell & Associates, Indianapolis, Ind.
Gemoets, E. L., radio-electrical engineer, KEPO Inc., El Paso, Tex.
Goodman, D. M., project director, New York University, New York, N. Y.
Gullatt, S. P., Jr., associate professor of electrical engineering, Louisiana Polytechnic Institute, Ruston, La.
Harder, M. N., senior electrical engineer, State of California, Sacramento, Calif.
Harding, W. T., technical director, equipment lab., Wright Air Development Center, Dayton, Ohio
Hill, V. E., electrical engineer, Brown & Sharpe Mfg. Co., Providence, R. I.
Ittner, C. K., electrical engineer, Aluminum Company of America, Vancouver, Wash.
Jones, J. F., engineer, Consolidated Gas, Electric Light & Power Co., Baltimore, Md.
Kelso, F., district switchgear engineer, Westinghouse Electric Corp., Baltimore, Md.
Kinyon, A. L., electrical engineer, Bonneville Power Administration, Vancouver, Wash.
Knepper, M. A., foreman, test sections, Westinghouse Electric Corp., East Pittsburgh, Pa.
Knight, A. G., manager, Central Iowa Power Cooperative, Cedar Rapids, Iowa
Labaugh, J. M., member of technical staff, Bell Telephone Laboratories, New York, N. Y.
Martin, J. E., engineer, Public Service Co. of Colorado, Denver, Colo.
McAninch, O. G., engineer, General Electric Co., Lynn, Mass.
McIntosh, C., Jr., design engineer, General Electric Co., Pittsfield, Mass.
Meader, R. R., radio transmission engineer, New England Tel. & Tel. Co., Boston, Mass.
Montgomery, W. O., system relay engineer, Public Service Co. of Indiana, Plainfield, Ind.
Morris, R. E., representative, Allis-Chalmers Mfg. Co., Washington, D. C.
O'Connor, W. H., Jr., engineer, Consolidated Gas, Electric Light & Power Co., Baltimore, Md
Reed, C. E., manufacturers agent, Lyman C. Reed, Inc., New Orleans, La.
Scheetz, J. E., administrative assistant, Rochester Gas & Electric Corp., Rochester, N. Y.
Schindler, H. J., chief, electrical & electronic section, Wright Air Development Center, Dayton, Ohio
Shambach, W. H., control specialist, General Electric Co., Philadelphia, Pa.
Shorter, O. L., electrical engineer, Delaware Power & Light Co., Wilmington, Del.
Shumaker, H. A., chief engineer, General Industries Co., Elyria, Ohio
Stack, S. S., laboratory assistant, General Electric Co., Schenectady, N. Y.
Ware, P. H., head, electrical laboratory, Simplex Wire & Cable Co., Cambridge, Mass.
Weaver, C. H., assistant professor, University of Tennessee, Knoxville, Tenn.
Wensel, R. W., assistant engineer, lighting dept., City of Seattle, Seattle, Wash.
White, G. M., consulting engineer, 802 Finance Bldg., Cleveland, Ohio
Wintrobe, W. C., group supervisor, products div., Bendix Aviation Corp., South Bend, Ind.
Wolosznek, B. M., electrical engineer, The Linderme Tube Co., Cleveland, Ohio
Wong, Y. S., instrument & test engineer, Hong Kong Electric Co., Hong Kong, China
Wright, L. L., asst. to manager, transformer engg. dept., Westinghouse Electric Corp., Sharon, Pa.
Young, R. E., power engineer, Public Service Co., Kankakee, Ill.

45 to grade of Member

Applications for Election

Applications for admission or re-election to Institute membership, in the grades of Fellow and Member, have been received from the following candidates, and any member objecting to election should supply a signed statement to the Secretary before August 25, 1953, or October 25, 1953, if the applicant resides outside of the United States, Canada, or Mexico.

To Grade of Member

duTreil, L. J. N., L. J. N. duTreil & Assoc., New Orleans, La.
Hollingsworth, F. M., Johnson & Phillips, Ltd., London, England
Mirrer, R., Raymond Mirrer Associates, New York, N. Y.
Pritchard, E. M., Machinery Electrification Co., Worcester, Mass.
Swarthe, E., Computer Research Corp., Hawthorne, Calif.

5 to grade of Member

AMERICAN INSTITUTE OF
ELECTRICAL ENGINEERS

Report

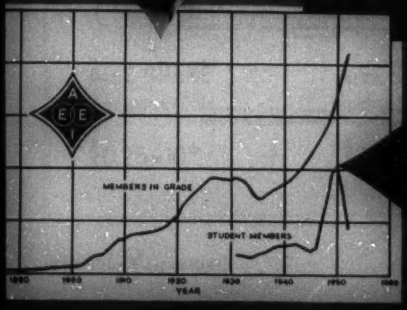
OF THE

BOARD OF DIRECTORS

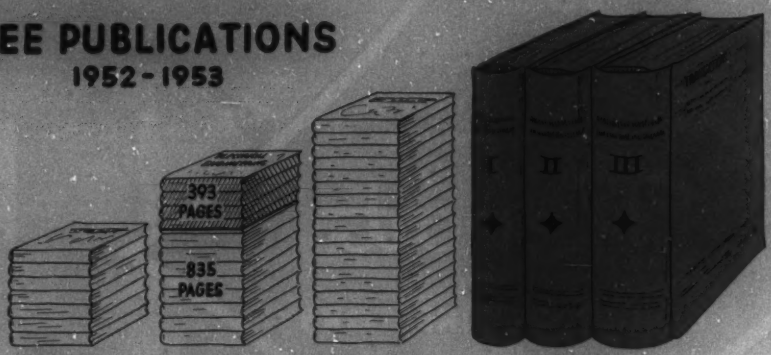
FOR

1952-1953

Vol. 72
1953



AIEE PUBLICATIONS
1952 - 1953



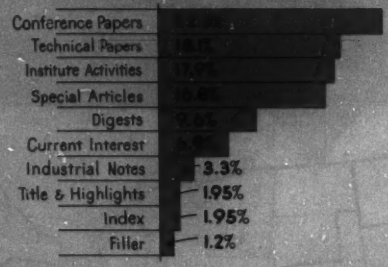
7 Special Publications
139 Articles
675 Pages

12 Electrical Engineering
160 Papers - 835 Pages
AIEE News, Notes, 393 Pages

18 Bimonthly Publications
234 Papers
1672 Pages

AIEE TRANSACTIONS
284 Papers
2076 Pages

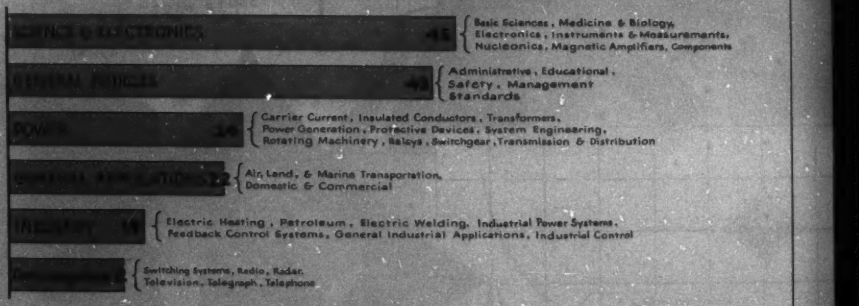
How 1228 Pages of Electrical Engineering Were Used in 1952-1953

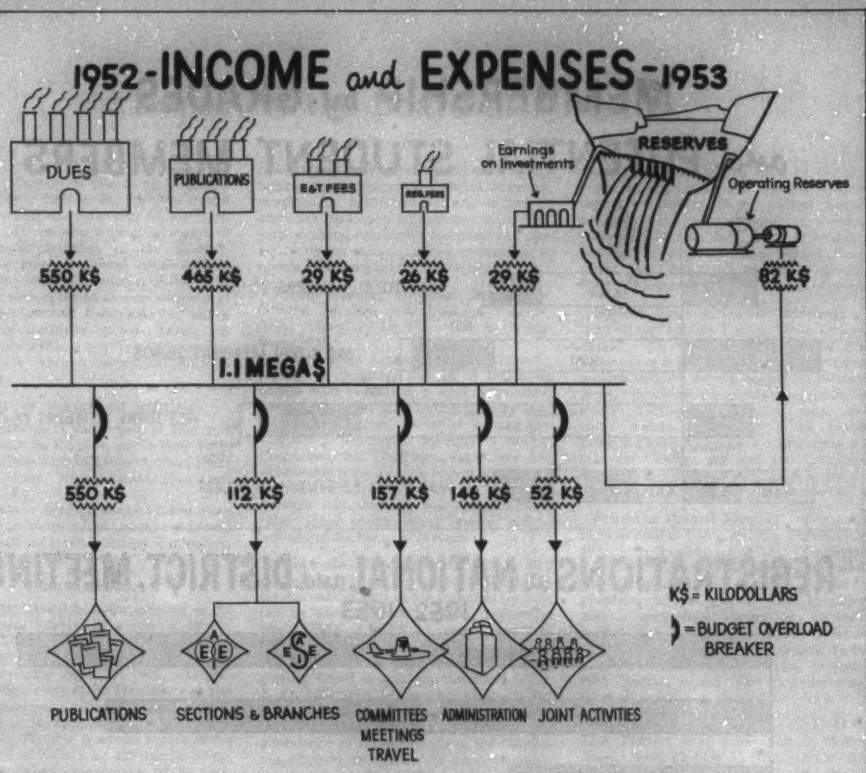


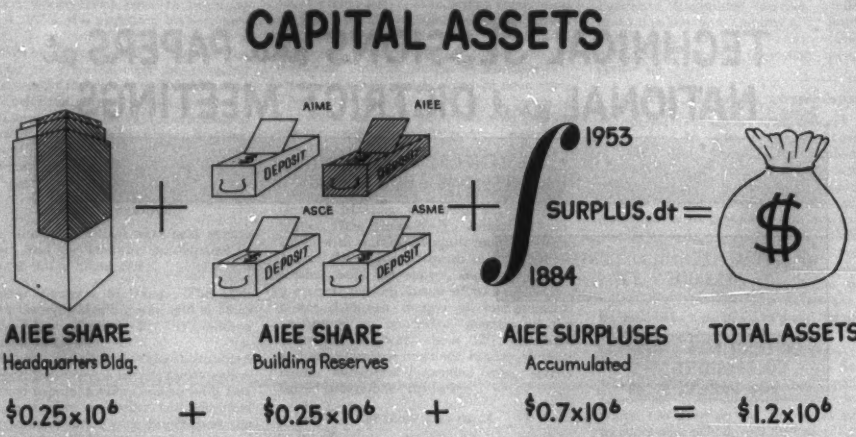
Subscriptions to Bimonthly Publications as of April 17, 1953

BIMONTHLY PUBLICATIONS	Free	Paid
Com. & Electronics	6,875	989
Appl. & Industry	4,350	1,640
Power App. & Systems	7,034	981
TOTALS	18,259	3,610
% Increase Since May 1952	34.4%	73.5%

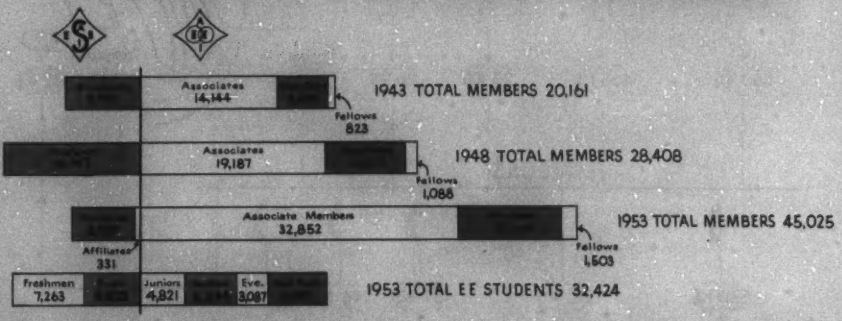
ELECTRICAL ENGINEERING SUBJECT MATTER
160 ARTICLES MAY 1952 - APRIL 1953


Basic Sciences, Medicine & Biology, Electronics, Instruments & Measurements, Nucleonics, Magnetic Amplifiers, Components
Administrative, Educational, Safety, Management Standards
Carrier Current, Insulated Conductors, Transformers, Power Generation, Protective Devices, System Engineering, Rotating Machinery, Relays, Switchgear, Transmission & Distribution
Air, Land, & Marine Transportation, Domestic & Commercial
Electric Heating, Petroleum, Electric Welding, Industrial Power Systems, Feedback Control Systems, General Industrial Applications, Industrial Control
Switching Systems, Radio, Radar, Television, Telegraph, Telephone


1952 - INCOME and EXPENSES - 1953
DUES
PUBLICATIONS
E&T FEES
REG. FEES
Earnings on Investments
RESERVES
Operating Reserves
550 K$
465 K$
29 K$
26 K$
29 K$
82 K$
1.1 MEGA$
550 K$
112 K$
157 K$
146 K$
52 K$
K$ = KILODOLLARS
= BUDGET OVERLOAD BREAKER
PUBLICATIONS
SECTIONS & BRANCHES
COMMITTEES MEETINGS TRAVEL
ADMINISTRATION
JOINT ACTIVITIES


CAPITAL ASSETS
AIME
AIEE
ASCE
ASME
DEPOSIT
1953
SURPLUS.dt =
1884
AIEE SHARE
Headquarters Bldg.
$0.25×10^6
AIEE SHARE
Building Reserves
$0.25×10^6
AIEE SURPLUSES
Accumulated
$0.7×10^6
TOTAL ASSETS
$1.2×10^6

MEMBERSHIP by GRADES and POTENTIAL STUDENT MEMBERS



REGISTRATIONS at NATIONAL and DISTRICT MEETINGS 1952-1953

TECHNICAL SESSIONS and PAPERS at NATIONAL and DISTRICT MEETINGS

Report of the Board of Directors

THE BOARD OF DIRECTORS of the American Institute of Electrical Engineers presents to the membership its 69th annual report, covering the fiscal year ending April 30, 1953. It contains a brief summary of the principal activities of the Institute during the year, a general balance sheet showing the financial condition of the Institute at the close of the fiscal year, a statement of cash receipts and disbursements, and a schedule of securities owned. Much additional information regarding the activities appeared in various issues of *Electrical Engineering*.

BOARD OF DIRECTORS' MEETINGS

Five meetings of the Board of Directors were held during the year, one in New York, N. Y., and one each in Minneapolis, Minn.; Phoenix, Ariz; New Orleans, La.; and Louisville, Ky.

Information regarding many of the more important matters which were considered by the Board of Directors appeared in various issues of *Electrical Engineering*.

ANNUAL MEETING

The 68th annual business meeting of the Institute was held in Minneapolis, Minn., June 23, 1952. A brief abstract of the annual report of the Board of Directors for the fiscal year ended April 30, 1952, was presented by Secretary H. H. Henline, who also gave a résumé of a report by Treasurer W. I. Slichter on Institute finances.

Secretary Henline read the report of the Committee of Tellers on the results of the vote on proposed amendments to the Constitution. All proposed amendments were declared adopted.

The report of the Committee of Tellers on the vote of the membership on the election of officers whose terms were to begin on August 1, 1952, was presented by Secretary Henline. President McMillan presented a President's badge to Donald A. Quarles who responded as President-elect by thanking the members for their confidence in him, and giving a brief address on Institute progress.

The Lamme Medal for 1951 was presented to Arthur E. Silver, retired, Ebasco Services, Inc., New York, N. Y.

President McMillan gave an address on "Our Achievements."

GENERAL MEETINGS

Four General meetings were held during the year, and the Institute participated in the Centennial of Engineering.

Summer General Meeting. The 68th Summer General Meeting was held in Minneapolis, Minn., June 23–27, 1952, with a registration of 1,786.

There were 36 technical sessions with about 160 papers presented, a management session with three papers, a safety session with four papers, a session on safety and electrical techniques in medicine with three papers, the annual meeting, a forum on the shortage of engineers, two sessions at which the nine District prize-winning papers were presented, a demonstration-lecture, a Section Delegates conference, meeting of the Board of Directors, meetings of many committees, numerous attractive inspection trips, several luncheons with speakers, President's reception and dinner, a dinner-dance, various entertainment events, and many events for the ladies.

Pacific General Meeting. The Pacific General Meeting was held in Phoenix, Ariz., August 19–22, 1952, with an attendance of 535.

The program included a general opening session, 13 technical sessions at which 42 papers were presented, a student technical session, forum on the shortage of engineers, a session on safety, a District 8 Executive Committee meeting, a meeting of Branch Counselors and Chairmen, inspection and sight-seeing trips, a chuck-wagon dinner with entertainment, color pictures of Arizona, a banquet with dancing and entertainment, other social events, ladies' events, and a meeting of the Board of Directors.

Centennial of Engineering. The AIEE participation in the Centennial of Engineering consisted mainly of five technical sessions, one by each technical division, September 10–12, 1952, at which 19 papers were presented, a luncheon at which the Faraday Medal of the Institution of Electrical Engineers, Great Britain, was presented to Dr. E. O. Lawrence, a luncheon at which Dr. M. J. Kelly gave an address on "Communications and Electronics," ladies' events, and attendance at various events of the Centennial planned for members of many engineering societies. The AIEE registration was 771.

Fall General Meeting. The sixth Fall General Meeting was held in New Orleans, La., October 13–17, 1952, with a registration of 920. In 22 technical sessions, almost 100 papers were presented. In addition, there was a general session, forum on the petroleum industry, session on management, session on safety, and a session on education. There were also a meeting of the Board of Directors, various committee meetings, stag smoker, dinner-dance, many inspection trips, and an elaborate schedule of events for the ladies.

Winter General Meeting. The Winter General Meeting was held in the Hotel Statler, New York, N. Y., January 19–23, 1953, with a record registration of 4,680. It had the largest program in history: 85 sessions, with 484 papers, and, in addition, a general session, forum of technical committee chairmen, session on management, conference on education, meeting of the Board of Directors, about 120 committee and subcommittee meetings, smoker, dinner-dance, numerous inspection trips, and a varied program for the ladies.

DISTRICT MEETINGS

North Eastern District Meeting (1952). This meeting was held in Binghamton, N. Y., April 30–May 2, 1952. The registration was 677. The principal parts of the program were 15 technical sessions with 64 papers, a student paper contest session, a District Executive Committee meeting, celebration of 50th anniversary of establishment of the Ithaca Section, Branch Counselors' and Chairmen's meeting, inspection trips, stag smoker, banquet, and ladies' events.

Middle Eastern District Meeting. A meeting was held in Toledo, Ohio, October 28–30, 1952, with a registration of 632. There were a general session, 15 technical sessions with 67 papers, session on management, microwave demonstrations, luncheon, smoker, banquet, inspection trips, and ladies' events. A meeting of the Middle Eastern District Executive Committee was held on October 27, and the Counselors and Branch Chairmen met at the University of Toledo, October 31 and November 1.

Southern District Meeting. This meeting was held in Louisville, Ky., April 22–24, 1953, with a registration of 457. There were a general session, nine technical sessions with 47 papers, an appliance conference consisting of two sessions with 10 papers and a symposium session on appliance protection, two student sessions, a conference of Branch Counselors and Chairmen, luncheon, numerous inspection trips, reception with buffet supper and entertainment, banquet and dance, and ladies' events.

North Eastern District Meeting (1953). This District held a meeting in Boston, Mass., April 29–May 1, 1953, with a registration of 847. The program included 11 technical sessions with 30 papers, the Northern Textile Conference with two sessions of two papers each and a luncheon, a general session, student paper session, District Executive Committee meeting, conference of Counselors and Chairmen of Branches, smoker with dinner and entertainment, banquet and dance, inspection trips, and ladies' activities.

SPECIAL TECHNICAL CONFERENCES

"Special Technical Conferences" were inaugurated in 1948, and have proved so successful that they are now planned and conducted as a regular Institute activity. The conferences are intended to be national in interest, technical in character, and concentrated as to subject matter toward one particular industry or objective. This type of meeting is designed to explore thoroughly a limited field, and to afford specialists in that field an opportunity to discuss mutual technical problems. The conference may be defined as a program of panel discussions, technical papers, or exhibits under the auspices of a national technical committee, in co-operation with an AIEE local Section, which might act as host to the conference. Operating under the policy and procedure which has been set up, the following conferences were held during the year:

Conference on Domestic Appliances. The third annual Conference on Domestic

Appliances attracted more than 160 appliance engineers to a discussion of "Domestic Appliance Controls" in Cincinnati, Ohio, May 16–17, 1952. A long-overdue interchange of technical information is now taking place among engineers in the appliance field, following the well-established practices. Papers were presented on most of the appliance control components, ranging from timers through thermostats, valves, solenoids, and harness connectors.

The conference was sponsored by the Subcommittee on Domestic Appliances of the Committee on Domestic and Commercial Applications, with the Cincinnati Section acting as host.

So much interest has been shown that a conference for 1953 was scheduled to be held in Louisville, Ky.

No conference proceedings were published.

Conference on Progress in Quality Electronic Components. Attended by more than 1,000 electronic engineers and technical authorities, the conference on "Progress in Quality Electronic Components" was held in the Auditorium of the Department of the Interior, Washington, D. C., May 5–7, 1952. The conference was sponsored by the AIEE, Institute of Radio Engineers (IRE), and Radio-Television Manufacturers Association (RTMA), and participated in by agencies of the Department of Defense and the National Bureau of Standards.

The primary problem facing electronic technology is the practical realization of electronic equipments which can deliver under a variety of adverse field conditions the same level of performance established for them in initial designs. Reliability is an important item, and should be studied on the basis of full understanding of component characteristics and ratings and by careful attention to proper application procedures.

Forty-seven papers were presented in ten sessions covering the following subjects: Electronics Today, Basic Materials, Advances in Miniaturization, Resistors, Capacitors and Inductors, Miscellaneous Components, Design and Production Methods, An Evening With Transistors, Aspects of Reliability, and Electron Tubes.

A complete conference report was published in booklet form.

Conference on Electronic Converter Applications and Tubes. Approximately 250 engineers from as far away as Louisiana, California, Washington, and Canada gathered in Pittsburgh, Pa., for the Conference on Electronic Converter Applications and Tubes, May 19–20, 1952.

Twenty-two papers were presented by representatives of the manufacturers and users of power converters. These papers, which covered all phases of the power-rectifier field, included general theory and basic principles of the various types, standardization, application, operation, and maintenance.

The conference was sponsored by the AIEE Committee on Electronic Power Converters and the Subcommittee on Electron Tubes of the Committee on Electronics jointly with the AIEE Pittsburgh Section.

It was the third of a series of conferences on electron tubes and their applications, and was devoted to larger power tubes and equivalent devices, such as metallic rectifiers and mechanical rectifiers. These power conversion devices find wide use in supplying direct current for the reduction of aluminum, electrochemical plants, street railways and railroads, coal mining, steel mills, and many other applications where direct current is required.

The proceedings of this conference were published in a bound volume. Copies may be obtained from AIEE headquarters at $3.50 per copy.

Conference on Telemetering and Remote Control. The Joint AIEE-IRE Conference on Telemetering and Remote Control was held in Long Beach, Calif., August 26 and 27, 1952, and was attended by over 300 persons. Four sessions were held during the 2 days, and 17 papers were presented. Subjects covered included both wire and radio telemetering.

The first session dealt with papers on telemetering pickups, and in the second session three papers dealing with problems of amplitude-modulation–frequency-modulation telemetering systems were presented. Radio telemetering problems, wire telemetering, problems of power systems, telephone systems, and petroleum production operations were discussed on the second day.

Complete proceedings of the conference will be published in booklet form and will be available at AIEE headquarters at $3.50 per copy.

Conference on Machine Tools. Some 400 electrical engineers from the machine tool and metal-working industries attended the fifth annual Machine Tool Conference sponsored by the Machine Tool Subcommittee of the Committee on General Industry Applications. With the Schenectady Section as host, the conference was held October 29–31, 1952, in the Hotel Ten Eyck, Albany, N. Y.

Machine tool drive applications were the subject of the papers presented at the technical session on Wednesday afternoon. On Wednesday evening, the annual banquet attracted approximately 300 persons. The principal speaker was Tell Berna, general manager of the National Machine Tool Builders Association, who discussed "The Machine Tool Industry at the Crossroads," including interesting comments on the problems faced by the machine tool manufacturers of the United States when competing in world markets against British, German, Italian, Swiss, French, and other European machine tool builders.

The Thursday morning technical conference was devoted to the problems of operator safety and electrical code requirements as they apply to machine tools. At the Thursday luncheon, H. A. Winne, General Electric Company, presented a thought-provoking talk on "Future Prospects for Atomic Electric Power Plants." The final technical session was held on Thursday afternoon.

Friday, October 31, was reserved for inspection trips to the Watervliet Arsenal, and the Schenectady Works of the General Electric Company. Manufacturing areas visited at General Electric Company included steam turbine and generator, gas turbine, induction motor, and electronic and magnetic control.

No conference proceedings were published.

Fall Textile Conference. The Fall Textile Conference was held in Raleigh, N. C., on November 6 and 7, 1952, with the North Carolina State College acting as host. Those attending were welcomed by Dean J. H. Lampe. The conference was sponsored by the AIEE Textile Industry Subcommittee of the Committee on General Industry Applications.

The attendance consisted of 201 persons from all levels of the industry. Papers covered problems of operating equipment, electrical problems of control maintenance, and codes and standards as they apply to this industry. Subjects were discussed from the floor and considerable exchange of ideas took place. In the afternoon of the second day, tours were conducted through the college.

No conference proceedings are to be published.

Conference on Recording and Controlling Instruments. A Special Technical Conference on Electrically Operated Recorders and Controllers, the first ever to be held on this subject, met in the Benjamin Franklin Hotel, Philadelphia, Pa., on November 17 and 18, 1952. The conference was sponsored by the Subcommittee on Recording and Controlling Instruments of the Committee on Instruments and Measurements, with the participation of the Industrial Instruments and Regulator Division of The American Society of Mechanical Engineers, and the Instrument Society of America.

The 2-day conference attracted a total registration of 515, representing all classes of users, including the oil, chemical, textile, steel, and rubber industries; public utilities; transportation; schools and colleges; government agencies and research laboratories; as well as the instrument manufacturers. The program was comprised of four technical sessions devoted, respectively, to new developments in the field of self-balancing recorders, electric controlling instruments, applications and systems, and new recording instruments. The titles of the 17 papers presented, together with a brief summary of each, were included in the conference program.

At the dinner on Monday evening, J. D. Rollins, United States Steel Corporation, spoke on "The Broad Aspects of a New Integrated Steel Plant," with particular reference to the new Fairless steel plant under construction near Philadelphia. At the Tuesday luncheon, R. M. Pennypacker, who recently returned from a 6-week visit to Great Britain as a member of a study panel representing the public utilities of the United States, spoke.

Complete proceedings of the conference will be published in booklet form and will be available at AIEE headquarters at $3.50 per copy.

Conference on Electronic Instrumentation and Nucleonics in Medicine. The newest developments in electronics and nucleonics pertaining to the medical field were explained and discussed at the fifth Conference on Electronic Instrumentation and Nucleonics in Medicine in the Hotel New Yorker, New York, N. Y., November 24–25, 1952. The conference was sponsored by the Committee on Electrical Techniques in Medicine and Biology. Seventeen technical papers were presented by physicians and engineers to an attendance of 188 members and guests, with the primary thought of an interchange of ideas so that

each group would know the other's problems, and so that electromedical science would be advanced.

The papers were presented in four technical sessions, featuring: (1) Electromagnetic and Ultrasonic Diathermy; (2) Electronic Devices for Ionization Measurement and Analysis of Isotope Mixtures; (3) Detection and Measurement of Radio Isotopes; and (4) Biological Uses of High-Energy Electrons.

Abstracts of papers were prepared and distributed at the conference. Some copies are still available to fill requests. No proceedings booklets are to be published for this conference.

Conference on Computers. New methods of electronic computer operation that should presage extended use in commercial and scientific fields were discussed by some of the nation's leading authorities at the second annual 3-day Computer Conference and Exhibition, sponsored jointly by the AIEE, IRE, and the Association for Computing Machinery. The conference was held in the Park Sheraton Hotel, New York, N. Y., December 10–12, 1952, and was attended by more than 1,200 engineers and guests.

The conference featured 27 technical papers on the input and output equipment used in computers. Thirteen manufacturers and scientific organizations displayed equipment used to record and feed information to the huge computing machinery.

The opening session of the conference featured a welcoming address, and presented a broad picture of subjects the conference was to cover, that is, the input and output portions of computing equipment. Other sessions covered applications of equipment, such as the basic methods employed for effecting the transfer of information between input-output equipment and the digital computers, considerations of the input and output systems of SEAC, UNIVAC, RAYDAC, and IBM 701, and various types of equipment.

Complete proceedings of the conference will be published in booklet form and will be available at AIEE headquarters at $4.00 per copy.

Conference on High-Frequency Measurements. The third Conference on High-Frequency Measurements was held in Washington, D. C., January 14–16, 1953, in the Auditorium of the Department of the Interior. The sponsors were the AIEE, IRE, and the National Bureau of Standards (NBS). Twenty-seven technical papers were presented at the four sessions, and two demonstration lectures were given at the Thursday evening joint meeting of the Washington Sections of the AIEE and the IRE. More than 700 engineers and guests attended the sessions and the luncheon on Thursday at the Hotel Statler, the conference headquarters.

One session was devoted to six papers dealing with the measurements of frequency, wavelength, and time, another to six technical papers covering measurement of power attenuation, a third to seven papers covering the measurement of transmission and reception, and a fourth to seven papers dealing with the measurement of impedance. The conference included a luncheon, inspection trips, and demonstration lectures.

Abstracts of papers were prepared and distributed at the conference. No conference proceedings were published.

Western Computer Conference. A 3-day conference, held in the Statler Hotel in Los Angeles, Calif., February 4–6, 1953, sponsored jointly by the AIEE, Association for Computing Machinery, and the IRE, was attended by approximately 800 electronic engineers and potential users of the new electronic computers. In addition to the technical sessions, more than 20 firms and organizations displayed latest developments in computer equipment.

Keynoting the conference were addresses by Dr. Simon Ramo, Vice-President of Hughes Aircraft Company, on "The Impact of Computer Developments on the Training and Utilization of Engineers," and Dr. R. D. Huntoon, Chief of the Corona (Calif.) Laboratories of the National Bureau of Standards, on "Factors Influencing the Effective Use of Computers."

There were five full sessions. The subjects of these sessions included: Commercial Applications; Applications to Aircraft and Missile Design; Panel Discussion on an Evaluation of Analogue and Digital Computers; New Developments in Digital Computer Equipment; and New Developments in Analogue Computing Equipment.

At a luncheon on Thursday, Dr. J. E. Hobson, Director, Stanford Research Institute, spoke on "New Equations for Management."

Brief abstracts of the papers presented were included in the program. Conference proceedings will be published.

Rubber and Plastics Conference. The Special Technical Conference on Electrical Engineering Problems in the Rubber and Plastics Industries was held in the Mayflower Hotel, Akron, Ohio, April 20 and 21, 1953. This was the fifth conference on this subject, and included an inspection trip to one of the large rubber plants in Akron.

This conference was sponsored by the Subcommittee on Rubber and Plastics of the Committee on General Industry Applications, with the Akron Section acting as host.

The conference was attended by approximately 200 persons, including representatives from engineering concerns, manufacturers, designers, users, and consultants. The papers covered electric power distribution, relay co-ordinating, electrical drives, differential transformers, grounding of power systems, precision control through servomechanisms, current limiting fuses, and the prospects of use of atomic power. Abstracts of the papers were included as a part of the published program.

Also included were a luncheon and banquet at which Earl Gulick of the Goodrich Company spoke. The conference had as its purpose the stimulation and encouragement of engineering papers and the promotion of standards and recommended practices in electrical engineering applications in the rubber and plastics industry. The conference was considered the most effective way to fulfill this purpose.

Proceedings of this conference will be published, and may be ordered at $3.50 per copy from AIEE headquarters.

Appliance Technical Conference. The Conference on Domestic Appliances was held during the Southern District Meeting in Louisville, Ky., April 22–24, 1953. It was sponsored by the Committee on Domestic and Commercial Applications. Persons attending the conference were able to join in the general meeting on Wednesday morning in common with others who attended the District meeting. They were also able to take part in the inspection trips available to others, as well as the inspection trip through the Appliance Park of the General Electric Company, which was of particular interest to them.

Ten papers and a symposium were on the program of the conference. It included subjects of control, basic metals, performance, design, grounding practices, and so forth, and a panel discussion on the role of fuses, circuit breakers, and thermal overloads in appliance protection.

Each session was attended by approximately 75 to 80 people. As this conference was combined with the Southern District Meeting, there were no accurate records as to the people who came specifically for the conference. However, from past experience, indications are that approximately 100 persons could be considered as interested in this conference. This is somewhat lower than when a conference is held independently. The committee is of the opinion that a conference has an advantage when held separately, and that the next should be held on that basis.

No proceedings are to be published.

Southern Textile Industry Conference. The Southern Conference on the Textile Industry was held at the A. French Textile School of the Georgia Institute of Technology, April 23–24, 1953. Eight papers were presented at the $2^1/_2$ sessions. On Thursday, the session was devoted to discussion of the practical merits of the present ungrounded 550-volt 3-phase 60-cycle 3-wire power, versus the proposed grounded neutral 3-phase 550-volt 60-cycle system under consideration by several engineering concerns, and lightning and lightning protection for various arrangements of textile mill buildings. The session on Friday morning featured discussion of motor torque requirements, motor overcurrent protection, and control connections; also various phases of electrical maintenance in textile plants were covered. There was a panel discussion on Friday morning covering the subject, "Electrical Troubles We Have Encountered." Some 142 persons attended this conference, which was sponsored by the Subcommittee on Textile Industry of the Committee on General Industry Applications. The lower attendance this year can be attributed directly to a cyclonic storm in the area of the conference.

No conference proceedings were published.

Joint AIEE, IRE, RTMA, and West Coast Electrical Manufacturers Association Conference on Electronic Components. The Conference on Electronic Components was held in Pasadena, Calif., April 29, 30, and May 1, 1953. The attendance at this conference, which was the first on this subject held on the West Coast, exceeded 1,500. The 3-day conference covered in general the critical problems being faced by the electronic industry in meeting industrial and military demands. The six open sessions covered: General Component Problems;

Environment and Packaging; Tubes and Tube Reliability; Component Reliability; Resistors, Capacitors, and Dielectrics; Devices and Materials.

There was also a classified session entitled "Reliability of Electronic Components in Guided Missiles," cosponsored by the California Institute of Technology Jet Propulsion Laboratory. Over 1,000 people made application for attendance at this classified session.

Distinguished luncheon and dinner speakers included Dr. James W. McRae, president, IRE, and vice-president, Bell Telephone Laboratories, Inc.; Major General Leslie E. Simon, Chief of Research and Development Division, Office of the Chief of Ordnance; and AIEE President D. A. Quarles, president, Sandia Corporation, and vice-president, Western Electric Company.

The conference was considered very successful, and fostered a better understanding of the important problems being faced by the electronic industry in producing components and equipment essential to the extreme demands placed upon it by military requirements in the field of missiles and aviation, and by industrial requirements in the fields of communications, controls, instrumentation, and television.

Northern Textile Industry Conference. The Northern Conference on the Textile Industry was held in the Sheraton-Plaza Hotel, Boston, Mass., May 1, 1953, during the North Eastern District Meeting. This conference was sponsored by the Subcommittee on Textile Industry of the Committee on General Industry Applications. There was an attendance of approximately 80.

Two papers were presented at each of the sessions. At the morning session, the first paper covered "Electric Equipment Built Into Textile Machinery," in which the problems and advantages of incorporating electric equipment into textile machinery by the manufacturer was discussed, with examples given by the author.

The second paper covered "Engineering Safety Into Electric Equipment," from the standpoint of insurance rates, with statistics showing the various causes of fires and the percentage caused by different classes of electric equipment in textile mills. This session was followed by a conference luncheon with a speaker, whose subject was "Can the Textile Industry Afford Engineers?" It was brought out that new synthetic fibers have produced new ideas in the textile industry, with new or modified weaving and other cloth-making processes, which call for new equipment and therefore require technical knowledge—an opportunity for the engineer.

A paper in the afternoon session traced the history of the textile machinery manufacture for the past 125 years and the gradual incorporation of various mechanical and electrical components into the design.

No conference proceedings will be published.

GENERAL COMMITTEES

BOARD OF EXAMINERS

The Board of Examiners met 11 times and acted on 4,575 applications and proposals in 1952–53. This average of over 400 cases per meeting represents a somewhat lighter load than the customary annual stint of the Examiners over the past few years. The fact that this was the first full year of operation under the revised constitutional requirements for the several grades of membership may account for the reduction in the number of cases presented to the Examiners. It certainly accounts for the unusually large amount of time and effort required of the members of the Board for their disposal. In arriving at its recommendations to the Directors for elections and transfers, the Examiners must interpret and apply the provisions of the Constitution to each individual application or proposal.

Table I. Applications and Proposals Received by the Board of Examiners, 1952-53

Admission		
Affiliate		
Recommended	288	
Not recommended	0	288
Associate Member		
Recommended	3,411	
Re-elected	138	
Not recommended	147	3,696
Member		
Recommended	47	
Re-elected	13	
Not recommended	10	70
Total admission cases		4,054
Transfer		
Associate Member		
Recommended	0	
Not recommended	1	1
Member		
Recommended	451	
Not recommended	43	494
Fellow		
Recommended	26	
Not recommended	0	26
Total transfer cases		521
Total cases		4,575
Student member enrollment		2,656
Grand total		7,231

In the course of the past year, several efforts were made to arrive at a satisfactory general statement of a working interpretation of the new provisions of the Constitution. These efforts culminated in a statement based on a comparison of the quantitative and qualitative requirements of the newly amended Constitution as compared with the old requirements. This was presented to the membership by the Chairman, C. W. Franklin, in *Electrical Engineering* for April 1953, pages 281–4, reprints of which have been widely distributed for use by the interested committees of the Institute.

Since much of the discussion of the problems of the Board of Examiners during the past year revolved about the new requirements for the grade of Fellow, it may be pertinent to observe that the present ratio of Fellows to the total membership stands at 3.32 per cent while the current list of 1,503 Fellows represents 29 per cent of the 5,188 Members reported in 1943 and therefore eligible on a purely time basis under the new requirements for the grade of Fellow in 1953.

During the year just ended it was necessary for the Board of Examiners to compare in detail the membership requirements of more than 20 American and foreign engineering societies with those of the AIEE for the purpose of determining whether applicants for the grade of Member under paragraph *d* of Section 5 of the Constitution could be recommended.

Numerous problems arose from efforts to evaluate the education of applicants for admission to the Associate Member grade who graduated from engineering colleges outside the jurisdiction of the Engineers' Council for Professional Development (ECPD) and for which special Board of Directors approval had not been provided.

There is reason to believe that the major difficulties of the transition to the new constitutional requirements have been overcome, and that, with a better understanding on the part of the membership, there will be an accelerated flow of soundly based and clearly documented applications and proposals in the coming years.

COMMITTEE ON CODE OF PRINCIPLES OF PROFESSIONAL CONDUCT

During the past year, the Committee on Code of Principles of Professional Conduct carried on an extensive correspondence, and held one meeting to discuss two complaints that had been submitted.

One complaint, from a consulting engineer, dealt with what was claimed to be an unfair practice on the part of utility companies in giving free engineering service to their customers. The committee thinks that in a free competitive society the private consultant should be prepared to meet competition from various sources, and that he has an obligation to see that his work meets the requirements of local regulations.

The other complaint dealt with a brief news item published in *Electrical Engineering* during the past Institute year. This particular release was also published in at least one other technical journal. The item was a technical publicity release from a reputable firm. It made no claims as to being the first, or the largest, or the only one of its type. The AIEE cannot guarantee originality, newness, or novelty in its publications. The Chairman had the pleasure of meeting the gentleman who complained, and enjoyed an amicable discussion of the matter.

The committee thinks strongly that young engineers do not want to join a labor union. Instead they desire a professional status equal to that of medicine and law. They are not satisfied with the Engineers Joint Council (EJC) membership, because they believe that a real professional society should have a membership of individuals, qualified as professional engineers. They point out a weakness and an inconsistency in the registration laws in that they identify an engineer by license and registration, and then exempt engineers in industry from the professional classification. It is hoped that the AIEE will take the lead in solving the problems.

COMMITTEE ON CONSTITUTION AND BYLAWS

The committee prepared and submitted to the Board of Directors, Constitution and Bylaw changes as required to meet the needs of Institute operation over the past year.

Constitution. Three amendments to the Constitution were prepared and are being voted upon by the membership. These amendments cover reorganization of the Nominating Committee, increase in number of Tellers, and Section reorganization.

At present, the Nominating Committee consists of ten members elected by the ten District Executive Committees and not more than ten from the Board of Directors. The Board believes it advisable and desirable to include representation from the technical divisions, and is recommending that the Nominating Committee be constituted of ten representatives elected by the District Executive Committees, one representative from each of the technical divisions, and representatives from the Board of Directors not to exceed in number the number of technical divisions.

An expanding membership has increased the work of counting, tabulating, and certifying the vote, and the Board is recommending that the Committee of Tellers be increased from seven to ten members.

The Sections amendment is part of a general revision of the Constitution and Bylaws to simplify committee structure and reduce committees to a practical size. In this amendment, the Section Chairman retains all of his essential duties and powers, and his access to the Sections Committee and the Board of Directors is unimpaired. Conferences and forums of Section delegates and other methods of communication among the Sections will continue and be made more effective as a result of this amendment.

Bylaws. The general revision of the Bylaws to eliminate ex-officio memberships and clarify committee operation and organization, which was started last year, has been completed. The following committees were revised: Edison Medal Committee, Section 71; Headquarters Committee, Section 73; Membership Committee, Section 77; Committee on Planning and Co-ordination, Section 78; Publication Committee, Section 80; Committee on Public Relations, Section 81; Committee on Research, Section 83; Committee on Safety, Section 84; and Committee on Transfers, Section 89. The changes in the Sections Committee required as a result of the constitutional amendment now before the membership have been approved in principle and will take effect as soon as the constitutional amendment is approved.

The chairmen of all other committees reviewed their committees and found them to be satisfactory without change.

Publications. The new policy of replacing the *Proceedings* with three bimonthly publications, *Communication and Electronics*, *Applications and Industry*, and *Power Apparatus and Systems*, required a complete revision of the Bylaws relating to publications to implement the policy. Revisions were made in Sections 99, 103, 105, 106, 107, and 110. Three new sections were added.

Fellow Grade—Requirements. In order to relieve the sponsors of a Fellow of the preparation of a citation, Section 2 of the Bylaws was revised to eliminate this provision. In order to obtain more complete information on members sponsored for Fellow grade so that suitable citations might be prepared, Section 2 was revised to call for detailed and concise information of the candidates' accomplishments which evidence achievements.

Transfers and Dues. The establishment of the Affiliate grade with its dues structure produced some inequities that required correction. Sections 12 and 13 of the Bylaws were revised to establish uniform transfer fees and to establish an equitable annual dues structure for this new grade.

General. This committee's plans are dictated by Institute operation, and Constitution and Bylaw revisions will be formulated as required.

COMMITTEE ON EDUCATION

During the past year, the committee had two meetings, one at the Fall General Meeting, and one at the Winter General Meeting. It also sponsored one conference session at each of these meetings.

The central theme of committee activities and of the two conferences has been concerned with the changes occurring in electrical engineering education and the industry, leading to de-emphasis or redirection of the traditional power education area. The committee has attempted by these conferences and by publication in *Electrical Engineering* to keep the Institute membership informed of the evolutionary changes taking place, as part of its duty to the Institute.

In New Orleans, La., the chairman presented the results of a committee-sponsored survey of engineering schools which showed current student interest to be 1.8:1 towards the electronic area over power, and emphasizing the disinterest of students towards the electrical utilities in many areas. Other speakers pointed out the employment possibilities of the electrical utilities and equipment manufacturing fields for electrical engineering graduates.

The subject was carried further by the very well attended conference in New York, N. Y., at which the subject of curriculum options was considered with particular emphasis on changes going on or anticipated with respect to the power option. The discussion varied from almost total elimination of options to a definite redirection of the power option or courses into an area of energy conversion and control. Audience participation in this conference was at a high level of interest and could have continued well past the adjournment time.

Committee meetings also emphasized this central topic of interest and the impending changes in electrical curricula. The discussion was broadened to include discussion of improved methods of teaching in the social-humanistic area and to a consideration of the position of the traditional physics course in the undergraduate curriculum.

In recent years, the Summer General Meeting either has conflicted with or closely paralleled the annual meeting of the American Society for Engineering Education. Many Institute members, unable to attend both so close together in time, have chosen to attend the latter meeting. As a result, discussion of educational matters at the Summer General Meeting has become difficult and unprofitable. This is a situation which the committee regrets.

HEADQUARTERS COMMITTEE

Basic repairs to the furniture in the Members Room, Board Room, and Secretary's office are under way and will be completed shortly. The air-conditioning units are scheduled to receive their annual servicing by June. Additional maintenance such as rug cleaning, repairing the covering on the walls in the Members Room and Board Room, and recovering cushions on upholstered furniture have been deferred pending a decision on plans to accommodate a larger staff.

The growth in membership has resulted in a need for expanding the headquarters staff. Accommodations for the added personnel are being investigated by this committee in co-operation with headquarters.

COMMITTEE ON MANAGEMENT

The immediate objectives of the Committee on Management are

1. To indicate to the members of the Institute the close relationship between engineering and management.
2. To outline to the members some of the principles, tools, and skills of management.
3. To inspire at least some members to study the art of management on their own initiative.
4. To show the need for all engineers to view engineering projects from a business as well as an engineering standpoint.

The committee cannot, of course, undertake to teach the subject of management to the members, for obvious reasons. However, it can outline the subject, show the need for management thinking on the part of the engineers, and give an occasional sample of the subject matter to inspire at least some of the members to study the subject further.

The committee held a conference session on management at each of the General meetings during the past 2 years, and a similar session at the Middle Eastern District Meeting in October 1952.

A session has been planned for the 1953 Summer General Meeting.

These sessions have included addresses on many phases of management, including training, incentives, techniques, work simplification, development of executive abilities, and so forth.

Except in one or two cases, the meetings were generally well attended, with from 100 to 150 persons present. A number of the papers presented at the conference sessions have been printed in *Electrical Engineering*, and a number more are to be published in the near future.

There have been a number of comments to the committee to the effect that the Institute gives too much attention to purely technical subjects, and far too little attention to the broad subjects of safety, management, and others in which engineers are vitally interested. The committee intends to move on aggressively in its work, but it must have greater support from the membership, if it is to be as successful as it should be.

COMMITTEE ON MEMBERS-FOR-LIFE FUND

As has been the practice in recent years, the fund was used to defray part of the expenses of the winners of District prizes incurred in attending the Summer General Meeting of the Institute. The privilege was accorded to both odd-numbered and even-numbered Districts.

In accordance with the requirement of the Board of Directors that the uses to which the fund is applied be reviewed each year,

Table II. Membership Statistics for Fiscal Year Ending April 30, 1953

	Honorary Members	Fellows	Members	6-Year Associate Members	Associate Members	Affiliates	Subtotals	Totals
Membership April 30, 1952	6	1,512	10,314	10,591	19,722	75		42,220
Additions								
New members qualified			43		4,242	257	4,542	
Former members reinstated or re-elected		1	41	118	202		362	
Subtotals		1	84	118	4,444	257	4,904	
Transfers		12	503	1,851			2,378	
Totals		13	587	1,969	4,444	257	7,282	
Deductions								
Died	1	30	65	54	24		174	
Resigned		3	61	132	230	1	427	
Dropped		1	86	332	678		1,097	
Subtotals	1	34	212	518	932	1	1,698	
Transfers			12	445	1,909		2,378	
Totals	1	34	224	963	2,841	1	4,076	
Net Changes	−1	−21	363	1,006	1,603	256	3,206	
Membership April 30, 1953	5	1,491	10,677	11,597	21,325	331		45,426

Table III. Number of Applications Received From Student Members and From All Others

Year Ending April 30	Students	All Others	Total
1953	1,614	2,405	4,019
1952	2,591	2,430	5,021
1951	4,168	2,082	6,250
1950	4,033	2,417	6,450
1949	2,286	2,192	4,478
1948	1,481	2,272	3,753
1947	938	2,331	3,269
1946	308	2,453	2,761
1945	249	2,179	2,428
1944	466	1,908	2,374
1943	783	1,431	2,214

Table IV. Number of Student Members as of April 30

Year	New Applications	Renewals	Total
1953	2,744	4,038	6,782
1952	3,023	5,834	8,857
1951	4,635	10,393	15,028
1950	7,876	12,792	20,668
1949	9,967	9,461	19,428
1948	7,876	6,041	13,917
1947	5,092	3,929	9,021
1946	2,574	2,513	5,087
1945	2,326	2,287	4,613
1944	2,242	2,656	4,898
1943	2,512	3,200	5,712

Table V. Record of AIEE Membership

Year	Total May 1	Year	Total May 1	Year	Total May 1
1884	71	1908	5,674	1931	18,334
1885	209	1909	6,400	1932	18,003
1886	250	1910	6,681	1933	17,010
1887	314	1911	7,117	1934	15,230
1889	333	1912	7,459	1935	14,269
1890	427	1913	7,654	1936	14,600
1891	541	1914	7,876	1937	15,308
1892	615	1915	8,054	1938	16,078
1893	673	1916	8,202	1939	16,605
1894	800	1917	8,710	1940	17,213
1895	944	1918	9,282	1941	17,886
1896	1,035	1919	10,352	1942	18,944
1897	1,073	1920	11,345	1943	20,161
1898	1,098	1921	13,215	1944	21,407
1899	1,133	1922	14,263	1945	23,072
1900	1,183	1923	15,298	1946	25,090
1901	1,260	1924	16,455	1947	26,470
1902	1,549	1925	17,319	1948	28,408
1903	2,229	1926	18,158	1949	30,791
1904	3,027	1927	18,344	1950	34,198
1905	3,460	1928	18,265	1951	38,058
1906	3,870	1929	18,133	1952	42,220
1907	4,521	1930	18,003	1953	45,426

the committee considered the matter and agreed that the present use of the fund is probably in the best interests of the Institute. The committee recommended, therefore, that the Board approve a similar use during the coming fiscal year.

COMMITTEE ON PLANNING AND CO-ORDINATION

The principal matters considered by the committee are summarized as follows:

Meetings. Recommendations regarding the locations and dates of various future General and District meetings were presented to the Board of Directors. With the approval of the Board of Directors, it was suggested to the Committee on Technical Operations that Student members not be expected to pay a fee when attending special technical conferences.

Various aspects of the situation arising from the presentation, at conference sessions and special technical conferences, of large numbers of informal papers with no provisions for publication were discussed, particularly with reference to possible effects upon General and District meetings.

Dues. The committee considered the results of recent discussions of the dues of Associate Members and Affiliates in several meetings of the Board of Directors. It recommended that the basic dues of Associate Members and Affiliates be considered to be $15 per year, but that provisions be made for reduction in dues to $10 per year for the first 6 years in either grade, or in both grades. The Board of Directors approved this recommendation, and amended the Bylaws accordingly.

Geographical Districts. Extensive consideration was given to the need for better balance among the Districts with reference to numbers of members, numbers of local organizations to be visited, distances involved, and so forth. A subcommittee was appointed to proceed with the studies and submit recommendations.

FINANCE COMMITTEE

A complete statement of Institute finances at the end of the fiscal year is included in the annual report of Haskins and Sells, Certified Public Accountants. It will be noted that an excess of income over expenses again has been achieved through the careful administration of operations by the headquarters staff, as well as the meticulous efforts of all committees to carry on their Institute functions with economy and efficiency.

The continued growth in membership and ever-expanding services to the members continue to demand the utmost attention to budget planning. The Institute is operating in its first year with a budget exceeding $1,000,000, and it is thought that, in spite of continued inflationary influences, the services to members can be provided without an imminent change in the dues structure.

MEMBERSHIP COMMITTEE

Membership in the Institute reached a new high of 45,426 at the close of the fiscal year. The increase of 3,206 during the year represented the fourth largest numerical gain on record. This is a gain of 7.6 per cent, a decrease from last year's figure of 10.9 per cent.

Table II shows the distribution of the membership changes among the various grades. The grade of Affiliate grew from 75 to 331 members during the year.

During the year 4,019 applications were received, of which 1,614 were from students and 2,405 from others. Student applications last year were 2,591, and 4,168 2 years ago. The decrease from these figures results largely from the decline in Student membership and will continue for 1 or 2 more years before being checked. In co-operation with the Committee on Student Branches and the Sections Committee, a follow-up of recent Student member graduates was instituted partially to counteract the trend. The applications from other than students is about the same as the 2,430 of last year.

Student membership continued to decline from 20,668 in 1950, 15,028 in 1951, 8,857 in 1952, to 6,782 this year. This decrease is principally due to the decline in student enrollments in engineering colleges. Efforts are continuing in encouraging enrolled students to become Student members.

Members in arrears for dues numbered 1,937, or 4.3 per cent; this is an improvement over the previous year when 2,047, or 4.8 per cent, were delinquent.

A new "Membership Information" booklet was prepared and distributed to the Sections during the year.

The committee is especially appreciative of the co-operation of the Student Branch counselors and of the Section chairmen in their efforts to counteract the decline in applications from Student members.

COMMITTEE ON AWARD OF INSTITUTE PRIZES

Institute prizes for technical papers presented during the previous administrative year were awarded in accordance with the rules approved by the Board of Directors on January 23, 1949, and subsequently revised on June 26, 1952. In continuance of previous inquiries, the committee has given consideration to possible revisions of present practices regarding prize awards. A number of tentative recommendations for modifications have been drawn up, but no final agreements have been reached. It has become apparent that present procedures are fulfilling in reasonable measure their pri-

mary purpose of recognizing meritorious papers, and that changes should receive careful deliberation.

PUBLICATION COMMITTEE

The publications work may be considered from the point of view of five broad areas of operation: namely, photolithographic preprints, *Electrical Engineering*, bimonthly publications, *Transactions*, and special publications. The total number of papers and pages published in each publication is given in Table VI. A high standard of publication has been maintained by continuing the policy to accept only original material.

Electrical Engineering. With the many diversified interests of members in mind, this publication has been planned to carry timely material of broad interest for the greatest number of members. In so far as possible the primary interests of members expressed in the Technical Division Publications Questionnaire have been used as criteria for the number of articles to publish in each of the five major divisions of technical activities. Also in each issue, an attempt is made to carry one or more articles in each of these five major divisions. The number of science and electronics articles has been increased from 27.8 per cent of the total number of the articles in the year previous to 38.4 per cent for the current year as shown in Table VII.

Articles for *Electrical Engineering* also are selected on the basis of breadth of interest. For example, many of the science and electronics articles contain principles which may be applied in the other four major divisions. Papers on microwave carrier and television stack monitoring although classified in the Power Division also are of interest to the Communication Division. A paper on insulation co-ordination is of interest to several committees within a division, because line, station, and apparatus insulation are usually involved.

Since bimonthly publications have been introduced and with a view toward avoiding duplication in so far as possible, the number of technical papers in *Electrical Engineering* has been reduced from 25.9 per cent of the total space to 18.1 per cent and the number of conference papers has been increased. The distribution of material in per cent of the total space is shown in Table VIII.

As approved by the Board of Directors in 1946 and subject only to general policy, the management and publication of *Electrical Engineering* are entirely the responsibility of the editor.

Advertising. The total number of paid advertising pages in *Electrical Engineering* for the year ending April 1953, was 970 pages as compared with 837 pages for the previous year, indicating a gain of 133 pages, or an increase of 16 per cent. The total number of paid pages for the first 4 months of 1953 was 324 pages as compared with 295 pages for the first 4 months of 1952, indicating an increase of 29 pages, or a gain of 10 per cent.

The Advertising Director attributes the increased business to our close contact with advertisers, the friendly service rendered, and the constant advertising campaign through "Standard Rate and Data," "Industrial Marketing," and the regular mailing of folders.

Bimonthly Publications. Beginning in July and August, 1952, three new bimonthly publications—*Communication and Electronics*, *Applications and Industry*, and *Power Apparatus and Systems*—were introduced on an annual subscription basis. These publications were announced in the Institute Activities sections of the March, July, and September issues of *Electrical Engineering* and a notice of availability to members has been carried on the Highlights page of every issue since August 1952. During the spring of 1952, a subscription card was sent to all members and each new member is sent a subscription card and circular of information about the publications when his election is qualified by payment of dues.

Bimonthly publications have met with popular response by the membership as evidenced by a 34.4-per-cent increase in the number of free copies and a 73.5-per-cent increase in the number of paid subscriptions during the 10 1/3 months' interval from May 27, 1952, to April 17, 1953, as indicated in Table IX. The data indicate that 18,259 members are obtaining these publications and several thousand are subscribing to one or two other divisions at the annual subscription rate of $2.50.

Bimonthly publications offer members a fast medium of obtaining the technical papers collated with discussions on a free basis or at nominal additional cost without the inconvenience of filling in and mailing order forms. The number of subscriptions is closely approaching the demand indicated by the Technical Publications Questionnaire

Table VI. Number of Pages of Published Material

	No. of Papers or Articles	Total No. of Pages	No. of Papers or Articles	Unduplicated Equivalent No. of Printed Pages
1. Photolithographic preprints	376†	5,900		
2. *Electrical Engineering*	160	702	115	480
3. *Proceedings* pamphlets*	128	1,142		
4. Bimonthly publications	234	1,672		
5. *Transactions* (Parts I, II, III)	284	2,076	284	2,076
6. Seven special publications	139	1,186	136	685
Totals			535	3,241

* Discontinued July 1952.

† Includes 45 AOO papers discontinued after April 1953.

Table VII. Comparison of Subject Matter in Electrical Engineering With Primary Interest of Members Indicated in Technical Divisions Publications Questionnaire

	Primary Interests of Members (Questionnaire)		Technical Articles in Electrical Engineering (Per Cent)			
			Year Ending in April			
	Number	Per Cent	1950	1951	1952	1953
Science and electronics	3,268	16.9	28.4	32.5	27.8	38.4
Communication	2,562	13.2	22.7	12.0	15.6	10.3
Power	8,537	44.0	31.8	36.0	32.8	20.5
Industry	3,231	16.7	11.4	12.0	16.0	12.0
General applications	1,405	7.2	5.7	7.5	7.8	18.8
None	393	2.0				
Totals	19,396	100.0	100.0	100.0	100.0	100.0

Table VIII. Material in Electrical Engineering, May 1952 to April 1953

	Number of Articles	Number of Pages	Per Cent Pages
Special articles	52	205.5	16.8
Technical papers	45	222.5	18.1
Conference papers	63	274	22.3
One-page digests	118	118	9.6
Filler items	48	15	1.2
Institute Activities		220	17.9
Current Interest		85	6.9
Industrial Notes, Trade Literature, and so forth		40	3.3
Title and Highlights pages		24	1.95
1952 Index		24	1.95
		1,228	100.00

Table IX. Increase in Subscriptions to Bimonthly Publications, May 27, 1952–April 17, 1953

	Free				Paid				Totals		
	May 27	Oct 1	Jan 8	Apr 17	May 27	Oct 1	Jan 8	Apr 17	May 27	Apr 17	Per Cent Increase
Comm. & Electronics	5,291	6,357	6,751	6,875	509	626	635	989	5,800	7,864	35.6
Appl. & Industry	3,156	3,698	4,008	4,350	982	1,373	1,394	1,640	4,138	5,990	44.8
Power Appl. & Sys.	5,149	6,173	6,647	7,034	590	904	913	981	5,739	8,015	39.7
	13,596	16,228	17,406	18,259	2,081	2,903	2,942	3,610	15,677	21,869	39.5
	Per cent increase 34.4				Per cent increase 73.5						

Table X. Special Publications Completed in the Year Ending April 30, 1953

		No. Papers	No. Pages
S-50	Electronic Converter Applications and Tubes (7/52)	25	164
S-48	Symposium on Polyethylene (7/52)	9	44*
S-46	Electric Arc and Resistance Welding III (10/52)	26	284
S-51	Electrical Engineering Problems in the Rubber and Plastics Industries (1/53)	17	216
S-53	Review of Input and Output Equipment Used in Computing Systems (3/53)	28	142*
S-54	Joint AIEE-IRE Conference on Telemetering and Remote Control (4/53)	17	144
S-52	Conference on Electrically Operated Recording and Controlling Instruments (4/53)	17	192
	Totals	139	1,186

* Printed

Survey and the cost of the first 6 months of operation indicates that the total estimated cost of these publications will be within the annual appropriation.

AIEE Transactions. The 1952 *Transactions* were made available in April in three parts to correspond with the bimonthly publications as follows: Part I. Communication and Electronics, 452 pages; Part II. Applications and Industry, 476 pages; Part III. Power Apparatus and Systems, 1,148 pages. Each of the three parts has been indexed separately and the preface to each part gives an explanation of the use of the indexes and the basis for classification of the subject matter.

AIEE Special Publications. Seven special publications were completed during the year as shown in Table X. In addition, seven of the older special publications which had been in considerable demand were reordered in quantities of 500–2,000. Several of the older publications were on fundamentals and are probably used for instruction purposes. The special publications are on a self-supporting basis.

Conference Papers. The Publication Committee, mindful of its responsibility to make the technical material available to the membership, has made a special study of the conference-paper problem. A survey was made of all authors of conference papers on the 1951 Fall and 1952 Winter General Meeting programs to which there was an 80-per-cent-return. Eighty-six per cent of the authors were willing to furnish the Institute with 50 copies of their papers. In respect to the question as to why their papers were a conference-type presentation, 201 replies expressed in per cent were as follows:

	Per Cent
(*a*). Lack of preparation time	36.8
(*b*). Difficulty of preparing manuscript	4.5
(*c*). Unsuitable for *Transactions*	22.9
(*d*). Desired to withhold release	14.4
(*e*). Committee requested as conference paper	21.4
	100.0

On the basis that the authors would be willing to bring 100 copies of conference papers to the meeting and to furnish Institute headquarters with 100 additional copies the annual distribution cost was estimated to be approximately $8,000 with a fixed cost of $1,000 for bins and additional floor space. The total cost of publishing 300 conference papers in the bimonthly publications was estimated to be of the order of $71,360. These costs were believed to be prohibitive and unwarranted.

As a trial and with the belief that there may not be as much of a demand for conference papers as expected, the willingness of 232 conference-paper authors on the program of the 1953 Winter General Meeting to distribute 100 copies of their papers directly was determined. A list of 115 such papers was published in the March and April issues and authors were asked to keep a record of the number of copies distributed within 6 months after the meeting. By July or August a good indication of the demand by the membership for conference papers should be determined.

COMMITTEE ON PUBLIC RELATIONS

Based on the experience gained in the past, the Committee on Public Relations has expanded its activities further along the lines recommended to the Board of Directors in Minneapolis, Minn., in June 1952.

The basic philosophy behind all the activities is to provide as much assistance as possible to the Institute, Districts, and Sections so that they will be able to do a more effective job in handling their publicity. The greatest part of the work is prepared by Raymond C. Mayer Associates, public relations consultants, under the general supervision of the committee and the headquarters staff.

The major activities may be briefly summarized as follows:

1. Preparation of news releases covering all phases of AIEE activities.
2. Preparation and distribution of Publicity Kit for use of Sections and Subsections. This is continually being brought up-to-date and is distributed each year.
3. A special "Publicity Manual" for meetings has been completed this year, and is being distributed to all Sections.
4. Representatives of Mayer Associates provide on-the-spot publicity service at many of the General and District meetings, and some of the technical conferences.
5. Publicity News Letters are prepared and distributed periodically. Five issues have been sent out during the current year.

The committee is much encouraged by the increased interest shown by the members throughout the Institute, and is now confident that the investment made by the Institute in the public relations program is paying off.

COMMITTEE ON REGISTRATION OF ENGINEERS

The committee has continued its efforts to advise the Institute membership, especially Student Branch members, on the subject of registration. The appropriate steps to accomplish this were reviewed again at a meeting held during the Winter General Meeting.

The committee is endeavoring to maintain an active position in matters of registration. The program devised last year for this purpose is developing satisfactorily. A paper prepared by one of the committee members appeared in the December 1952 issue of *Electrical Engineering*, pages 1082–7. The chairman of the committee met with the chairmen of the Sections Committee and the Committee on Student Branches in a joint effort to work out a co-ordinated plan of activity to provide a list of competent and available speakers in all parts of the country on the subject of registration. A pamphlet now being prepared will take this into account. A representative of the committee spoke at the Sections Committee meeting in January, and is scheduled to speak before it again in Atlantic City, N. J., in June.

The practice, begun in the 1950 Year Book, whereby each registered professional engineer was indicated by a dagger, was continued in the 1952 edition. Although this is clearly requested on the information card sent to all members, some remain improperly identified in this matter. It is hoped that more will fill out their cards correctly in the future.

COMMITTEE ON RESEARCH

The Committee on Research has given serious consideration to ways and means of encouraging research required by the electrical industry. It appears that the majority of our universities and colleges do not appreciate the extent to which continued research is required. For this reason, adequate emphasis on many fields of research is not being given in the majority of the colleges. In an effort to stimulate interest in this type of work, the committee will sponsor, at the Summer General Meeting, at least three, and possibly four, papers aimed at bringing to the attention of the industry generally, and particularly to the colleges and universities, the desirability of increasing the research effort in several fields appropriate to the interests of the electrical industry.

During the past year, discussions were held relative to the problem of liaison between the Committee on Research and the various technical committees and divisions. As a result of these discussions, the technical divisions were requested to select individuals to provide the necessary liaison function and to work with the Committee on Research as members of it. These men have been chosen, and met with the other members of the committee during its last meeting. It is believed that this will provide an adequate means for interchange of ideas between the Committee on Research and the technical divisions and committees.

COMMITTEE ON SAFETY

Noteworthy activity of the Committee on Safety during the past year includes: (1) initiating and sponsoring several unusual safety programs; (2) healthy growth of the new division-liaison activity started last year; and (3) encouraging progress in several long-range projects concerning electrical safety.

Safety sessions were held at the four General meetings, but certain papers and sessions are particularly noteworthy. For example, a formal paper revealed to the Institute for the first time the effect of the new push-pull techniques of artificial resuscitation when extended to apply to the pole-top method. A special panel-session

discussing fundamentals and present practices of electrical grounding for safety drew an attendance of 300. Another session discussing causes and cures of static hazards in operating rooms was highlighted by an hour-long demonstration. This extremely successful meeting was attended by about 400, including more than 100 from the medical profession who signed guest cards. The two meetings probably set new attendance records for AIEE safety sessions. Interesting sessions projected for the future include a forum comparing the activities of different organizations working on electrical safety; and a panel discussion on safe leakage currents in electrical products.

The liaison activity with the five technical divisions that was started last year has shown substantial progress. Co-operation extended by the divisions has been cordial, interested, and helpful. Practically every liaison representative actively has explored and urged each technical committee to integrate timely safety papers into its regular sessions. The outstanding success of the Industry Division in this effort deserves especial note and commendation. Recently the liaison idea was extended to invite several general committees, such as the Committee on Education, to participate. The long-range results of this move look promising.

To stimulate discussion of safety at the Section level, President Quarles sent a letter to all Section chairmen urging that at least one discussion of electrical safety be included in their program during the year. Chairman Tatum, of the Committee on Student Branches, issued a similar letter to all Student Branches.

The special-project group working on an authoritative AIEE pamphlet on electric shock, has made exceptional progress during this year. When completed, this booklet will be a major Institute contribution and will fill a safety need that has existed in industry for a long time. Work still is moving forward on the long-range special project of a field-type defibrillator for ventricular fibrillation from electric shock. The work of the special project on co-operating with other organizations working on electrical safety will benefit substantially from the forum planned for the 1953 Summer General Meeting, comparing the fields of activities of different groups. A co-ordinated and informed effort among all organizations working on electrical safety is a long-range objective that should pay off handsomely.

SECTIONS COMMITTEE

Section Activities. During the past year, three new Sections were organized, bringing the total to 98. The Ridgway Section, formerly a Subsection of the Erie Section, was approved by the Board of Directors in June 1952. The former Mobile-Pensacola Subsection of the Alabama Section has been organized as a Section; also, the former Hamilton Subsection of the Toronto Section assumes Section status as of May 1, 1953.

Several new Subsections also have been organized: Monroe, La., of the Shreveport Section, Atlantic City of the Philadelphia Section, Eastern North Carolina of the North Carolina Section, Tullahoma of the East Tennessee Section, Huntsville of the East Tennessee Section, Lexington of the Louisville Section, and Paducah of the Louisville Section. Similar organizations are being activated in other geographical areas where growth in local membership makes it desirable to have separate units.

The Tri-State Section, comprising areas in Kentucky, West Virginia, and Ohio, was officially renamed the Ohio Valley Section.

Interim Meeting. The committee held its usual interim meeting during the Winter General Meeting, with attendance by representatives from the Sections, as well as officers and District secretaries. General affairs of the Institute, such as finances, redistricting study by the Committee on Planning and Co-ordination, and matters of Section operation and management, such as student guidance, membership, transfers, publicity, Student Branches, Section Growth Award Plan, the formation of Subsections, and technical discussion groups were discussed. Minutes of this meeting were circulated to all Sections for their information and guidance.

Special Activities. During the Summer General Meeting, former Vice-Chairman H. A. Dambly presented a forum discussion on "The Shortage of Engineers." Following presentations by Colonel Carey H. Brown, Chairman, Engineering Manpower Commission of the Engineers Joint Council; Dean Ovid W. Eshbach, dean of Technology Institute, Northwestern University; and J. Harold Foote, president of Commonwealth Associates, Inc., an active discussion by Section representatives brought out many ways in which the Sections can co-operate in their local areas to stimulate interest among science-talented young people in the profession of engineering. Complete minutes of the discussions and formal presentations later were sent to all Sections.

A revision of the booklet "Section Activities" has been completed by a special subcommittee under the chairmanship of Dixon Lewis, and is available for distribution at the 1953 Summer General Meeting. Incoming officers of the Sections will find this booklet very helpful in planning their program of activities during the coming year.

At the 1952 Summer General Meeting, the Section Growth Award Plan was made current by presentations for accomplishment in the two previous administrative years. First prize in the larger-than-average group was awarded to the Maryland Section for 1950–51, and to the Toronto Section for 1951–52. The smaller-than-average group award for first place was presented to the Louisville Section for 1950–51, and to the Toledo Section for 1951–52. Second place award for the larger-than-average group was presented to the Milwaukee Section for 1950–51, and to the Seattle Section for 1951–52. In the smaller-than-average class, second place awards were given jointly to the Arkansas Section and Georgia Section for 1950–51, and to the Syracuse Section for 1951–52. In future years, all awards will be presented at the close of the current administrative year.

Following a national survey of Section preferences by a special subcommittee under the chairmanship of J. P. Neubauer, the committee recommended and the Board of Directors approved the use of a standard emblem of award to past Section chairmen. This consists of a standard lapel pin of color corresponding to grade of membership, surrounded by a gray enamel band on which the words "Past Section Chairman Award" appear in gold letters. The reverse side of the emblem is suitable for engraving with the name of the recipient, his Section, and date of award. These pins are now available at headquarters and cost $6.00 each, postpaid.

The Sections Committee continued to promote the formation of womens' auxiliaries, and a number of new units were organized during the past year.

Significant changes in the Constitution and Bylaws now define more clearly the scope of duties and responsibilities of the Sections Committee, and should bring about a closer working relationship with the Sections. All Section officers are urged to read revised Section 58 of the Constitution and Section 85 of the Bylaws, which will appear in the 1953 Year Book.

The Sections Committee co-operated with the Committee on Student Branches and Membership Committee in the distribution of Student member record cards at all colleges and universities operating Branches. These cards, with first employment addresses of Student members, were forwarded to interested Sections for follow-up by their local membership committees.

STANDARDS COMMITTEE

The Standards Committee held three meetings, all of them well-attended both by the regular members and the liaison representatives from the technical committees, who have taken an active part in discussions relating to their fields.

Probably because of the new technical committee structure, there has been considerable interest on the part of some of the technical committees in the Institute's representation on American Standards Association (ASA) committees and in the whole subject of the preparation of American Standards. Much time has been devoted,

Table XI. Section and Branch Statistics

	For Fiscal Year Ending April 30					
	1948	1949	1950	1951	1952	1953
Sections						
Number of Sections	81	84	87	89	94	97
Number of meetings held	1,340	1,561	1,605	1,716	1,747	1,786
Total attendance	109,637	128,025	135,847	125,779	128,362	135,276
Branches						
Number of Branches	127	129	130	132	132	133
Number of meetings held	1,172	1,350	1,298	1,281	1,157	1,239
Total attendance	77,040	103,828	80,672	62,630	48,386	45,895

therefore, to a discussion of this subject, so that the functions of the various groups in the Institute will be clear and the cordial cooperation so necessary to the smooth flow of standards stimulated.

At the last meeting, Cyril Ainsworth, Technical Director of ASA, very kindly accepted an invitation to outline ASA activities and answer questions regarding joint efforts in the standardization field. In view of the part played by the Institute in the formation of the ASA, and its expressed policy of supporting American Standards to the greatest possible extent, the educational value of such a discussion for the benefit of the rapidly changing technical committee membership seemed to warrant the time so spent.

While Institute representatives to ASA committees are selected primarily on the basis of their individual fitness for the assignment, a constant effort is made to have the representatives balanced with respect to the source of their experience.

Two standards co-ordinating committees have completed their assignments and have been discharged with thanks, Committees *2* and *5*, but the other six have been very active. These activities are reported separately in *Electrical Engineering*.

The Standards Manual has been brought up-to-date by a special subcommittee and the new edition should be available soon for publication.

The chief changes have been in the balloting procedure of the technical committees, so as to provide a complete record of the returns of the committee members and the substitution of liaison representatives from the various technical committees for the ex-officio members eliminated by the Board of Directors.

Under the new procedure, each technical committee is invited to appoint a liaison representative to the Standards Committee to attend meetings of that committee and perform the dual function of reporting to the Standards Committee on technical committee activities and of reporting to their technical committees on the Standards Committee's activities to whatever extent the representatives judge desirable. Many of the technical committees have taken advantage of this invitation and have appointed the vice-chairman as the liaison representative, so that if the normal procedure of having the vice-chairman succeed the chairman at 2-year intervals is followed, both the new chairmen and their respective vice-chairmen will be thoroughly familiar with the Standards Committee's operations and better co-ordination thereby obtained.

The following standards work was completed during the past year:

Revision of Automatic Circuit Reclosers for A-C Distribution Systems, Number *50*.

Guide for Operation and Maintenance of Dry-Type Transformers With Class *B* Insulation, Number *53*.

Standard, Test Code, and Recommended Practice for Induction and Dielectric Heating Equipment, Number *54*.

Guide for Temperature Correlation in the Connection of Insulated Wires and Cables to Electric Equipment, Number *55*.

Revision of Preferred Standards for and Standard Specification Data for Generators for Large 3,600-Rpm 3-Phase 60-Cycle Condensing Steam Turbine Generators, Numbers *601–602*.

Revision of D-C Aircraft Rotating Machines, Number *800*.

Some work was also done on the following items:

Revision of ASA *C-5*, Code for Protection Against Lightning, in our capacity as a cosponsor.

Flexible Cord and Fixture Wire Standard of Underwriters' Laboratories, Inc., for Submission to ASA.

UNITED STATES NATIONAL COMMITTEE OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION

Nineteen countries were represented by 418 delegates at a series of meetings of the International Electrotechnical Commission (IEC) at Scheveningen, Holland, in September 1952, to discuss international agreement on electrical standards. The United States, represented by 14 delegates, participated in almost all of the technical meetings.

Among important actions taken this year at the IEC meetings, was authorization of a new technical committee to develop standards for electronic tubes. This work heretofore has been part of the duties of Technical Committee *12* on Radio-Communication. Organization of the new Technical Committee *39* recognizes the fact that the use of electronic tubes has now extended into a much broader field than radio alone. This follows the development of standardization in the United States. The Secretariat for the new technical committee was assigned to the Netherlands Electrotechnical Committee.

A number of standards were completed and will be submitted to the national committees for approval. These included revision of the specifications on rotating electric machinery; preferred standards for 50-cycle turbines and for 3,000-rpm 3-phase 50-cycle turbine-type generators; a basic list of graphical symbols; a revised list of standard voltages; power losses and methods of expressing efficiency of electric equipment; safety rules for amplifiers and loudspeakers; several standards for radio components; temperature rise for circuit breakers, normal loading conditions; a revision of standards for power capacitors; dimensions of electronic tube bases and tube gauges; and two specifications for high-voltage insulators.

The IEC Council, the Commission's governing body, and the Committee of Action, its executive committee, considered strengthening co-operative relations between IEC and other international organizations. Arrangements were made for extending co-operative action on standards of joint interest to IEC and the International Commission on Rules for the Approval of Electrical Equipment (CEE). This is a European organization developing safety rules for radio receivers, loudspeakers, amplifiers, television receivers, household appliances, wiring devices, and similar equipment. It is now extending its activities into other fields closely related to those covered by IEC. The rules adopted by CEE are used by European governments in inspection and approval of electric equipment.

Closer co-ordination of IEC work with that of the International Organization for Standardization (ISO) was discussed also.

A request from the Organization for European Economic Co-operation (OEEC) for the fastest possible progress on projects which OEEC believes would help in stimulating international trade was given serious consideration. These are in the field of light electric equipment, including domestic appliances for room heating and cooking, protective devices for motors, medical appliances and X-ray apparatus for medical use, arc-welding apparatus, measuring instruments, radio receivers, and interference-suppression devices. In most cases there are now differences in standards used by different countries for these types of equipment. The request is being passed along to the Secretariats for the projects in question and arrangements are being made for close liaison with OEEC in the future.

Suggestions for new work considered by the Committee of Action included expansion of the project on graphical symbols and increased activity on switchgear to include contactors, starters, bus bars, switchgear assemblies, and the like, both for low and high voltages, except for domestic installations. Work on electroacoustics was revitalized and the Secretariat of Technical Committee *29* transferred from the British National Committee to the Netherlands National Committee. A meeting of Technical Committee *29* is to be held in The Hague, June 11–13, 1953.

Dr. H. S. Osborne, formerly president of the United States National Committee, was elected President of the IEC at the Council meeting in Scheveningen on September 10, 1952.

R. C. Sogge of the General Electric Company was elected President of the United States National Committee at the December 2, 1952, meeting in New York, N. Y.

At the invitation of the Yugoslav National Committee, the 1953 meetings of the IEC will be held in Opatija, Yugoslavia, June 22 to July 4, 1953. Meetings of the following technical committees have been scheduled:

Experts Committee of Technical Committee *3*—Graphical Symbols
Technical Committee *12*—Radio Communication
Subcommittee *12-1*: Measurements
Subcommittee *12-3*: Components
Technical Committee *15*—Insulating Materials
Technical Committee *17*—Switchgear
Technical Committee *20*—Electric Cables
Technical Committee *22*—Power Converters
Subcommittee *22-1*: Power Converting Equipment
Technical Committee *34*—Electric Lamps
Subcommittee *34A*: Lamps
Subcommittee *34B*: Lamp Caps and Holders
Subcommittee *34C*: Auxiliaries
Technical Committee *37*—Lightning Arresters
Technical Committee *39*—Electronic Tubes
Committee of Action

Following the usual action by the technical advisors and sectional committees concerned with the IEC work, a considerable number of delegates to the foregoing meetings have been obtained. It is expected that at least one representative will be present at all of these meetings.

Plans are going forward for the 50th Anniversary Jubilee meetings of the IEC which will be held at the University of Pennsylvania, in Philadelphia, during the first 2 weeks of September 1954. The United States National Committee hopes that this meeting will be a real opportunity for the engineers who make up the sectional committees responsible for the IEC work to meet with corresponding representatives from the 28 other countries which form the membership of the IEC.

COMMITTEE ON STUDENT BRANCHES

Mentioned in the last annual report was the possibility of increasing the allotment for the operation of Student Branches. Upon the recommendation of the Committee on Student Branches, the Board of Directors voted

that the appropriation for each Student Branch be $1.00 per year per member as of November 1, in addition to the regular appropriation of $25.00 per year; expenditure of the $1.00 per member portion to be subject to no restrictions, but expenditure of the $25.00 portion to be subject to the same restrictions as Section appropriations. The November 1 count will include all Student members registered in the school at that time. This includes graduated Student members continuing in the school or transferring from another school as graduate students, but excludes graduated Student members employed in industry.

During the past year, the following schools were approved for the establishment of Student Branches: Laval University (Quebec City, Quebec, Canada), Saint Louis University, and the University of Dayton.

The Board of Directors approved the recommendations of this committee that the presentation of papers at the Summer General Meeting by winners of District Branch Competitions be discontinued. This action was based on the poor attendance at the paper session and its adverse effect on the Students. The winners of the District Branch Competitions will be introduced during the Summer Meeting. Branch Counselors have been reminded that exceptional Student papers may be submitted for one of the regular sessions through the usual channels.

Another recommendation approved by the Board of Directors was that of providing a Certificate of Authorization for Branches in schools where the electrical engineering curriculum has been accredited by the ECPD.

A large part of the activities of the Committee on Student Branches has been the consideration of foreign schools with regard to the educational requirement for Associate Membership. Under current requirements, an applicant for Associate Membership must be a graduate of a school approved by the Board of Directors (or have 5 years of engineering experience). In the United States, this means that the applicant must be a graduate of an ECPD accredited curriculum (not necessarily electrical). In the case of foreign schools, approval is to be recommended by the Committee on Student Branches. To date, the Board has approved the committee's recommendations on English and Canadian schools. At the present time, the other foreign schools are being considered.

The Subcommittee on Joint AIEE-IRE Student Branch Co-ordination held a meeting on March 25, 1952. This subcommittee is exploring the possibility of establishing joint Student Prize Paper Competitions at Branch and District levels, and is considering paper rules, geographical Districts, and paper awards.

Two committee meetings were held: one in Minneapolis, Minn., June 23, 1952, and the other in New York, N. Y., January 20, 1953.

COMMITTEE ON TECHNICAL OPERATIONS

The Committee on Technical Operations is a merger of the former Technical Program Committee and Technical Advisory Committee, established for the purpose of supervising the technical affairs of the Institute, co-ordinating the activities of the technical divisions, arranging programs for technical sessions at General meetings, receiving and handling reviews of all papers by the technical committees, and other administrative duties as required in such technical affairs. Three meetings of the committee have been held during the first year of its operation.

Handbook for Technical Committee Operations. One of the first activities of the Committee on Technical Operations is preparation, still in progress, of a handbook containing the essential information needed for co-ordinated action by technical committee chairmen, authors of papers, chairmen of sessions, meetings committees, and others having to do with technical operations. This manual will include: (1) the essential material now contained in the current manual of the former Technical Program Committee, (2) suggestions to technical committee chairmen, (3) excerpts from the Standards Manual, (4) excerpts from "Information for Authors." The last-named will include specific instructions and sample copy to guide stenographers and draftsmen, as well as authors, thus reducing editorial correspondence with authors who submit unusable copy.

Classifications of Papers. Papers presented at General and District meetings of the Institute have been divided into three classes—*Transactions* papers, advance copy only, and conference papers. Considerable study and discussion have taken place to improve this classification, particularly since "advance copy only" carries with it an appearance of inferiority. It has been agreed by the Committee on Technical Operations to eliminate this classification.

To make conference papers suitable for publication in the *Transactions*, it has been customary to present them "by title only" for discussion. It is believed that changing this to "re-presented for discussion," and providing a brief period for the author to summarize the highlights of his papers, would encourage more discussion. It has been voted, therefore, to use this latter notation for such papers and to recommend that the presiding officer at a session allow time for such re-presentation.

Problem of Conference Papers. "Conference" papers originated some years ago as the outgrowth of round-table discussion on timely topics on subjects in formulative stages. When certain individuals were requested to "lead discussions," some leaders established the practice of presenting their remarks in mimeographed form for distribution at the conference. In recent years, these "conference papers" have been placed on the program with the same status as *Transactions* papers.

Since 1944, when conference papers first appeared on an equal basis with *Transactions* papers, they have increased until, as exemplified by the 1953 Winter General Meeting, they comprise more than 50 per cent of the total. It has been charged that some conference papers are used for a variety of purposes, some questionable, such as to advertise commercial products, to circumvent the 90-day advance disclosure to competitors, or simply to circumvent any advance reviews. On the other hand, many Institute members believe that timely presentation of a subject requires that it be done without the formal process of review and consequent delay in presentation. The Committee on Technical Operations is engaged in a study of this problem.

Special Technical Conferences. Special Technical Conferences have become an established part of the technical activities of the Institute, many of them bringing together several hundred persons at a single conference although sessions on the same subject at General meetings may draw only about ten per cent as many. While such conferences have been highly successful and are self-supporting, the problem of publication of the papers, to make the records available to all members of the Institute, requires considerable study. Some opinion has been expressed that official *Transactions* status should be given to some of these papers. It has been agreed to refer this matter to the Publication Committee for further review.

Papers by Nonmember Authors. A special subcommittee of the Committee on Technical Operations is studying this problem. In the meantime, a new form letter has been prepared for use in obtaining acceptance of papers by nonmember authors, for *Transactions* papers only. Approval of the chairman of the Committee on Technical Operations is required.

Appointment of Non-AIEE Members to Technical Subcommittees. This subject was reviewed by a special subcommittee of the Committee on Technical Operations and, upon its recommendation, the Committee on Technical Operations voted to place these appointments under the jurisdiction of the pertinent division chairmen. Appointment of nonmembers is desirable when such nonmembers have specialized knowledge that will benefit the activities of the Institute.

Presentation of Student Prize Papers. Difficulties experienced in scheduling presentation of Student Prize Papers before suitable audiences at General meetings has resulted in the Committee on Technical Operations deciding to discontinue these presentations and to provide for the introduction of the prize winners at the general session of the Summer General Meeting.

Division Committees. Serving as the co-ordinating agency for the technical activities of the technical committees are five division committees. These divisions are Communication, General Applications, Industry, Power, and Science and Electronics. Chairmen of the technical committees within each division are members of the pertinent division committee.

Co-ordination of the work of the several technical committees in each division has been accomplished by division committee meetings held principally at Institute General meetings. Questions of jurisdiction and scopes of technical committees have been amicably settled at these meetings, and schedules for future technical sessions agreed upon. Estimates of the papers to be available are submitted to the Committee on Technical Operations to aid in preparing for future meetings.

Co-operation between divisions and between the Institute and other societies has been enhanced by the division method of operation. One example of this was the participation of several divisions in the

Centennial of Engineering, held in Chicago, Ill., in September 1952.

TECHNICAL DIVISIONS AND COMMITTEES

Communication Division

COMMUNICATION DIVISION COMMITTEE

Uniquely characteristic of the Institute year now ending is a growing consciousness among engineers that the scope of electrical communication is destined to comprehend more than just the language transducers: telephony and telegraphy. Under impact of progress in the fields of television and electronic computers, among others, where the end product of the information analysis and transmission process is obviously divorced from language considerations though carried out by techniques indigenous to voice and record communication, the past year has witnessed increasing pressures upon the older boundaries of the communication domain.

The transmitter, the medium of propagation, and the receiver now are being looked upon together as a unit machine, however geographically remote its termini, into which information is fed, processed, transmitted, reprocessed, and finally either is displayed in some form of intelligence, or is put to work to control other machines. From such controls are conjured up the concepts of the automatic factory and the remote operation of business machines and publishing media. From such processing and reprocessing of information, involving classification and memory devices, compression and re-expansion through codification, and the employment, at very high speeds, of some of the analytical functions of the human mind, arises the feeling that communication engineering will devise more and more apparatus to take over the drudgery of repetitive thinking in much the same way that electric power has taken over human muscular exertion, and in doing so similarly will supplement man's capacity and effectiveness.

The consummation of these possibilities will depend, of course, upon extension of the technology which is the subject matter of the various technical committees of the Communication Division, and will involve the considerable segment of AIEE now splendidly being served by the Institute publication *Communication and Electronics*, inaugurated in July 1952. In this periodical, the subject matter of General and District meetings is reaching and serving a growing number of members whose interests are included in the scope of the Wire, Radio Communication, Telegraph, Television and Aural Broadcasting, Communication Switching Systems, and Special Applications Committees.

A survey conducted early in the administrative year indicated that the broadening field of communication well could be served by the six committees as presently constituted. The activities of the year, as recorded in the several committee reports, seem to bear out the soundness of this judgment.

Beyond the meetings reported as technical committee activities, the Communication Division sponsored an appropriate general interest session at the Centennial of Engineering celebration in Chicago.

COMMITTEE ON COMMUNICATION SWITCHING SYSTEMS

The committee believes that the techniques employed in communication switching systems have extensive applications in the general field of information processing and automatic control. Through its technical programs it is attempting, not only to report progress in communication switching, but also to bring to the attention of a broad segment of the electrical engineering profession the techniques which long have been used in these systems.

During the year, three committee meetings were held, and four technical sessions were sponsored, one each at the Summer and Fall General Meetings, and two at the Winter General Meeting. The session at the Summer General Meeting was of particular interest, and was well attended. It featured a symposium of four papers on nation-wide toll dialing. The papers presented at the Fall General Meeting primarily reported new developments in telephone switching systems and apparatus. One of the sessions of the Winter General Meeting was planned to present telephone switching systems and general switching circuits as examples of complex automata. As an innovation, several large demonstration units were used at this session. These included mechanized displays for nation-wide dialing, error detecting and correcting codes, and C. E. Shannon's mouse which solves a maze through the control of telephone-type relays. This session was favorably received by a large audience. The second session at the Winter General Meeting was devoted to new developments for recording and processing information on telephone calls for accounting purposes.

The committee has made plans for a technical session at the Summer General Meeting, which will include papers on mathematical methods of switching circuit design and the use of transistors in a telephone switching system application.

COMMITTEE ON RADIO COMMUNICATIONS SYSTEMS

The committee sponsored technical sessions at each of the General meetings. At two of these, the committee met and reviewed activities. The outstanding development in radio communication in recent years is the growth in the use of microwave relay systems. The committee discussed at some length how best to serve the membership in disseminating technical information on applications of microwave radio, particularly in the railroad, pipe-line, petroleum, and power industries. An aggressive policy of papers procurement is being followed, while the possibility of a technical conference is being studied.

COMMITTEE ON TELEGRAPH SYSTEMS

This committee sponsored a well-rounded technical session at the Winter General Meeting, covering recent developments in wire and cable, including the experimental laying of a section of nonarmored submarine cable. In addition, a committee meeting was held to set up objectives and lay out the course for the coming year. The results of this meeting indicated a growing interest in facsimile, particularly in its pictorial aspects, and the committee plans to present an interesting session on this subject at the forthcoming Summer General Meeting.

COMMITTEE ON TELEVISION AND AURAL BROADCASTING SYSTEMS

The rapid developments in various fields of broadcasting have continued to receive the attention of the committee, and meeting sessions were arranged to bring these developments before the membership. These fields have included the extension of television broadcast service into the ultrahigh frequencies in the band from 470 to 890 megacycles and standardization activities in color television looking toward the practical establishment of national service. The first AIEE session ever scheduled on binaural broadcasting, a field in which active interest now is being taken, was arranged for the Atlantic City program.

Other committee activities have included suggestions to the Committee on Research of fields related to broadcasting where fundamental research is needed, and suggestions to the Edison Medal Committee of suitable candidates for that honor.

COMMITTEE ON WIRE COMMUNICATIONS SYSTEMS

The committee sponsored technical sessions at the Fall and Winter General Meetings, and committee meetings were held coincident with these meetings to plan future meetings. Arrangements have been completed for sponsoring sessions at the forthcoming Summer and Pacific General Meetings.

Much of the interest for the past few years in wire communications systems centers around the carrier art. Four papers on new short-haul carrier telephone systems were presented at the Fall General Meeting. Two papers were descriptive, while the third and fourth papers discussed the application of one of the systems and new transposition designs to be employed to control open-wire crosstalk. The papers at the Winter General Meeting dealt with a new long-haul coaxial cable system, and covered the system application, amplifiers, equalization and regulation, and television terminals.

No further work was done on establishing standards for wire communications systems. There appears to be little need for such standards at this time.

General Applications Division

COMMITTEE ON AIR TRANSPORTATION

The Committee on Air Transportation participated in the Middle Eastern District Meeting in October 1952, holding five technical sessions, where 26 timely and interesting papers were presented. Many of the papers were fully approved, and are available for publication in *Transactions*.

The annual business meeting of the committee was held on October 31, 1952, in Toledo, Ohio, with 25 members present. A decision was made to hold a technical conference in Seattle, Wash., during the fall of 1953, since no General or District meetings are being held in an area that would attract a sufficient number of interested engineers.

The various subcommittees of the com-

mittee have been active; a summary of their activities is as follows.

The Subcommittee on Aircraft Control, Protective Devices, and Cable prepared a test code on aircraft circuit interrupting devices, and issued it on a 1-year trial basis. This code has been revised as a result of its trial period, and is being circulated to obtain final approval for permanent use. A test code for aircraft carbon-pile regulators has been issued to obtain final approval.

Society of Automotive Engineers (SAE) Subcommittee *A-2* has requested AIEE to prepare a test code for solenoids, relays, and contactors. This assignment has been accepted by the above subcommittee.

A new subcommittee was formed to study and formulate dielectric testing standards for aircraft electric apparatus. The test code for electric d-c rotating machinery has been revised by the Subcommittee on Aircraft D-C Rotating Machinery, and is being submitted to the Standards Committee. A new test code for a-c rotating machinery is under revision. This subcommittee has received a request from SAE Subcommittee *A2G* to prepare standard methods of testing for presenting data on aircraft generators to enable users of such apparatus to apply them intelligently. Work on this program is proceeding on an accelerated basis.

The Subcommittee on Altitude Ratings has had its name changed to "Rating of Air-Borne Electric Apparatus Subcommittee" and its scope will cover "treatment of the effects of flight through the atmosphere on the rating of air-borne electric apparatus. Reports and guides are to be prepared defining the relationship between pressure, temperature, and other atmospheric properties on the performance of electric apparatus."

The Subcommittee on Aircraft Electric Systems has conducted a survey to determine the revisions necessary to make AIEE Standard Number *700* conform to general practice in the industry. The survey indicated that 14 and 28 volts should be designated as nominal d-c system voltages for d-c aircraft systems. Such action has been approved by the Committee on Air Transportation and the Systems Subcommittee will revise the Standard and submit it to the Standards Committee for action.

The subcommittee also is engaged in sponsoring the complete revision of the "Report on Aircraft Electric System Guide, AIEE Number *750*." Sections of this report are being revised by other subcommittees, where those subcommittees have definite responsibilities for apparatus described in the particular sections.

The subcommittee has been charged with surveying present installations to determine the magnitude of voltage drops between a-c generator terminals and the point of regulation on aircraft a-c systems, with a view toward setting up better standards for alternator terminal voltage ratings.

COMMITTEE ON DOMESTIC AND COMMERCIAL APPLICATIONS

The activities of the committee have been carried on during the past year through the medium of four subcommittees.

Subcommittee on Electric Space Heating and Heat Pumps for the East Coast again sponsored its annual session at the Winter General Meeting. Since the heat pump and the radiant panel space heating methods have been through the field test and development stages and now rapidly are becoming a reality, progress reports were made and many studies were reported at the meeting covering the load factor and the effects of such loads on the distribution system. Much interest is being shown and considerable work is being done on the methods of storing heat to reduce this load factor.

Subcommittee on Electric Space Heating and Heat Pumps for the Pacific Coast has been inactive during the past year, but is currently planning a technical conference on heat pumps for the fall of 1953.

Subcommittee on Domestic Appliances held its third annual Technical Conference on Domestic Appliances in Cincinnati, Ohio, with the theme "Appliance Controls." This is a very broad field and great interest was shown in it. As a result, the fourth annual Technical Conference on Domestic Appliances was held in Louisville, Ky., in conjunction with the Southern District Meeting.

The subcommittee sponsored a paper on the history of the development of electric appliances which was presented, in Chicago, at the Centennial of Engineering as a part of the General Applications Division meeting.

Subcommittee on Farm Electrification participated in the 1952 National Farm Electrification Conference held in Detroit, Mich. Since it was voted to disband this activity, the subcommittee now is planning a session on farm electrification to be held in Fort Wayne, Ind., in October or November 1953. It is thought that this conference, to be sponsored by the subcommittee in conjunction with the Fort Wayne Section, will be very fruitful since there is a wide variety of applications and increasing interest in the electrification of the farm.

General. During the past year, considerable work has gone into the completion of the roster of interested engineers and technical people in the appliance industry. For the current Technical Conference on Domestic Appliances, a roster of about 750 people who are interested in this activity has been compiled. The AIEE should be the logical place for the technical people of the appliance industry to meet and exchange information. The last three technical conferences on domestic appliances have proved adequately that this is correct, as many of the people in the appliance industry have become interested in the AIEE because of this activity.

COMMITTEE ON LAND TRANSPORTATION

In general the work of this committee is devoted to two principal divisions: heavy traction, and light traction.

The heavy traction division covers the activities of rail operations, namely, steam, mining, and industrial. The light traction division covers the activities of the transit companies involving urban, suburban, and rapid-transit operations, with both rail cars and rubber-tired vehicles. These two divisions are assigned to two subcommittees. During the past few years, the papers delivered at General and District meetings have been divided about equally, but very little attempt has been made to group these papers around a general subject. A grouping subject plan was started with the 1953 Winter General Meeting.

The first session was devoted entirely to rapid transit, the second session was devoted to diesel locomotive operation, while the third session was devoted principally to diesel locomotive electrical maintenance. An analysis of this meeting indicated an appreciable increase in attendance and interest, and an improvement in the grade of papers. Also, it was thought that the coverage of three major subjects by a group of papers from various industries and sections of the country provided a more comprehensive treatment of the subjects than would have been possible by presenting individual papers on the same three subjects over a period of 2 or 3 years, or in several Districts. Proof of the interest in these symposium-type meetings last winter is evidenced by a total attendance of 330 for the three sessions.

During the past few years, this committee has attempted also to raise the grade of transportation papers by influencing authors to produce technical papers rather than conference papers. Although some papers, because of necessity, must be conference papers, the proportion of technical papers to conference papers has been quite high. In the last 2 years, this committee has been responsible for 28 technical papers, 9 conference papers, and 1 advance copy only paper.

During August 1951, a representative of the Committee on Land Transportation attended the London, England, meeting of the International Electrotechnical Commission. Subsequently, this representative emphasized the necessity of taking an active part in the work of the IEC. As a result, AIEE Committee *11* was re-established. The personnel of Committee *11* also is included on the ASA Committee *C-35*.

The Europeans have been working on rules and standards of the IEC for a number of years, but have expressed the desire to enlist the co-operation and advice of United States associations. Since the scope of the IEC covers not only electric locomotives, streetcars, and compound motors for trolley coaches, but also motors, generators, and controls for diesel locomotives, it is quite apparent that the committee should assist this organization.

The next meeting of IEC will be June 8–11, 1953, at Interlaken, Switzerland. Again, the Committee on Land Transportation will be represented by a voting delegate. In the meantime, Committee *11* will continue to study the American Standards for Rotating Electrical Machinery on Railway Locomotives and Rail Cars and Trolley, Gasoline-Electric, and all Oil-Electric Coaches, the subject assigned, and will be guided to a great extent by the representative attending the June committee meeting in Switzerland.

COMMITTEE ON MARINE TRANSPORTATION

The Committee on Marine Transportation, during meetings on June 27, 1952, and October 10, 1952, reviewed various comments on the December 1951 issue of AIEE Standard Number *45*, "Recommended Practices for Electric Installations on Shipboard."

As a result of many complaints from ship

operators concerning the unsatisfactoriness of electrically operated galley equipment, a special subcommittee was appointed. This subcommittee communicated with ship operators and manufacturers, in order to provide a standard which would eliminate many of the present difficulties. This subcommittee has presented a draft of standards and "recommended practices" for galley equipment. This draft has received favorable action by the main committee, and probably will be made a part of Standard Number *45* when next published.

A special subcommittee was appointed to take steps to sponsor a complete session at the 1954 Winter General Meeting, to be known as the Marine Session. The special subcommittee is to co-operate with the New York Section in preparing for such a session.

The Subcommittee on IEC Standards has been reviewing the first comprehensive draft of a proposed "Code on Electrical Installations on Ships," prepared by the Technical Committee Number *18* of the IEC. Comments thereon are being compiled for possible presentation to the Commission.

COMMITTEE ON PRODUCTION AND APPLICATION OF LIGHT

Significant progress was made throughout the year in light sources, their applications, and in the control of electric discharge lamps. These developments were discussed at a session of the Winter General Meeting, in which papers given reviewed recent advances in incandescent, mercury, and fluorescent lamps, together with ballasts and circuit control devices.

Radiation in the infrared and ultraviolet regions adjoining the visible spectrum also are included in the responsibility of this committee. Much work is being done in these comparatively new fields, and another valuable session held at the Winter General Meeting was devoted to ultraviolet radiation for air sanitation and product protection, photochemical applications of ultraviolet, and industrial uses of infrared.

Much of the emphasis of the first half of the year was devoted to the report for the Centennial of Engineering. The result of this work appeared in AIEE *Transactions*, volume 71, part II, 1952. Under the title "Electric Lighting in the First Century of Engineering," it outlines the historical development of lighting as a science, an art, and an industry. Well documented, it is a unique and valuable contribution to this particular branch of electrical engineering. A condensation of this work was given as part of the AIEE program at the Centennial of Engineering in Chicago on September 12, 1952.

A strong program is being planned for the 1954 Winter General Meeting, on the general subject of maintenance, including controls and wiring.

Industry Division

COMMITTEE ON CHEMICAL, ELECTROCHEMICAL, AND ELECTROTHERMAL APPLICATIONS

The committee met during the Winter General Meeting. The subject of proposed changes in the award of prizes for technical papers as discussed at a prior meeting of the Industry Division Committee was presented to those in attendance at this meeting for information purposes. Questions regarding the committee and subcommittee rosters were discussed, particularly in regard to participation of qualified AIEE members and available mechanisms for suggesting persons for membership on the committee and subcommittees.

This committee plans to participate in the Summer General Meeting, and also is to take an active part in the preparation of the program for the Pacific General Meeting. Participation by the committee in the Middle Eastern District Meeting in Charleston, W. Va., and the Fall General Meeting was discussed and plans formulated.

Among the activities of the committee for the past year were sessions in Minneapolis, Minn., covering the subjects of electrothermal processes and storage batteries. At the Fall General Meeting, sessions were held on cathodic protection and the "Petroleum Industry in the South." At the Winter General Meeting, sessions relating to the petroleum industry, cathodic protection, and electrochemical processes were held.

The committee plans to hold more individual subject conferences designed for purposes of stimulating discussion. Co-operation with other committees in order that the individual subject can be covered as completely as possible from the standpoint of equipment design and operating experience is being looked into. Greater efforts in coordinating programs with other committees are expected to be put forth in future meetings.

Cathodic Protection Subcommittee. Two full sessions were conducted by this subcommittee during the year; one at the Fall General Meeting and the other at the Winter General Meeting. This committee is continuing its work in the investigation of effects of cathodic protection on railway signal systems and is also studying grounding practices in general. Consideration is being given by the subcommittee to the promotion of research and short courses on cathodic protection. The subcommittee plans to aid in obtaining papers for the Pacific General Meeting and is expected to participate in the Middle Eastern District Meeting in Charleston. A full technical session will be held at the Fall General Meeting, and one session will be held at the Winter General Meeting.

Chemical Industry Subcommittee. This subcommittee participated in the Fall General Meeting, and at present plans a session at the Middle Eastern District Meeting. Plans also include participation in the Winter General Meeting.

Electrochemical Processes Subcommittee. This subcommittee sponsored a full session at the Winter General Meeting, and plans to participate in the Middle Eastern District Meeting. Also included in its plans is the arrangement of a session at the next Winter General Meeting.

Electrothermal Processes Subcommittee. This subcommittee sponsored a full technical session at the Summer General Meeting. Plans are presently being formulated to hold a full session at the Middle Eastern District Meeting.

Petroleum Industry Subcommittee. This subcommittee conducted a petroleum industry forum at the Fall General Meeting for the purpose of discussing and determining how the AIEE better could serve petroleum industry engineers. The subcommittee sponsored one technical session at the Fall General Meeting under the general subject "Petroleum Industry in the South." One session was held at the Winter General Meeting.

This subcommittee plans to sponsor three technical sessions at the Fall General Meeting, one session at the Summer General Meeting, and one session at the Winter General Meeting.

Storage Battery Subcommittee. This subcommittee sponsored a full technical session at the 1952 Summer General Meeting, and plans to hold a session at the 1953 Summer General Meeting.

COMMITTEE ON ELECTRIC HEATING

The first Institute conference covering the full scope of "Industrial Electric Heating" was held in the Detroit-Leland Hotel, Detroit, Mich., May 26–27, 1952, under joint sponsorship of the Committee on Electric Heating and the Michigan Section. Twenty technical papers were presented in five sessions during the 2-day conference covering: furnaces, resistance heating devices, radiant heating, induction and dielectric heating, controls, instrumentation, heat transfer studies, and industry progress, including European practice.

The papers were presented by well-known authorities in their respective fields with speakers from manufacturers, utilities, research, and educational organizations. A high level of interest was displayed by the large attendance and the active participation in discussions. Similar conferences are planned for other major industrial areas by the committee and its subcommittees.

Earlier in the year, a Proposed Standard Test Code and Recommended Practice for Induction and Dielectric Heating Equipment was adopted and made available for distribution as AIEE report number *54*, by the Subcommittee on Induction and Dielectric Heating. Additional subcommittee meetings were held during the year, and co-operation was extended to the Federal Communications Commission (FCC), the IRE, and the Committee on Ovens and Furnaces of the National Fire Protection Association.

COMMITTEE ON ELECTRIC WELDING

During the Winter General Meeting, the committee sponsored a technical session on power supply for resistance welding. This session was repeated from the Third Conference on Electric Welding, held in Detroit, April 1952, for the benefit of engineers in the eastern states who could not attend that conference. The papers were presented by the original authors, who were key men on the subcommittee which prepared the report on power supply for resistance welding machines.

In order to obtain a better understanding in the industry, a technical session on utility charges for service to resistance welders was held. This matter of utility rates has been an important problem in the welding industry. The session was requested to provide for the clarification of various contro-

versial points, and to offer an opportunity for the welder manufacturers, users of welding equipment, and electrical utilities to discuss the factors involved.

The Committee on Electric Welding held business meetings in Philadelphia, Pa., in October, during the National Metal Exposition and Fall Meeting of the American Welding Society, also during the AIEE Winter General Meeting. Plans were made for future technical sessions, and the organization work was started for the Fourth Conference on Electric Welding, which will be held in Milwaukee, Wis., May 1954.

Subcommittee on Fundamental Electric Arc Research has completed its new "Bibliography on High-Pressure Electric Arcs." The present 200-page typed manuscript includes about 2,200 references, submitted by the subcommittee members and many other contributors. Estimates are being obtained from the printers, and it is expected that the bibliography, after reduction, will be printed in a book of about 50 pages. A meeting of this subcommittee was held in January 1953.

Subcommittee on Instrumentation for Resistance Welding has established three active working groups to study the application of various instruments for measurements required in resistance welding. The members are co-operating closely with representatives of other interested groups, including the American Welding Society, National Electrical Manufacturers Association (NEMA), and the AIEE Committee on Instruments and Measurements. When completed, the results will be published for use by the welding industry.

COMMITTEE ON FEEDBACK CONTROL SYSTEMS

The Committee on Feedback Control Systems has had very active participation by the members, and there has been wide interest in the technical programs.

Technical sessions, involving presentation of 20 papers, were conducted at the Fall General Meeting, Middle Eastern District Meeting, and Winter General Meeting. Plans for the Summer General Meeting are well along for presentation of eight papers.

The committee has two subcommittees which are active and are producing results. One is the Subcommittee on Terminology and Nomenclature which is working to submit a standard for approval to the AIEE Standards Committee. Much interest has been shown in this work both in the United States and abroad. Some of the work is controversial, but every attempt is being made to obtain agreement through ASA with The American Society of Mechanical Engineers (ASME) and IRE, which also have groups working on the subject.

The work has covered nomenclature and terminology based upon the comprehensive block diagram proposed in 1951. In addition, definitions descriptive of system performance have been prepared for submission as standard. These will be reviewed by the main committee at the Summer General Meeting, after which it is planned to submit the material to the AIEE Standards Committee.

The Subcommittee on Bibliography has compiled and submitted the first two bibliography lists on the subject of feedback control systems. Part I covers general articles on feedback and its uses; Part II is devoted specifically to regulators; and Part III will cover other specific subjects in the field of feedback control systems. It is planned to publish all parts in *Electrical Engineering*.

At the meeting of the Committee on Feedback Control Systems held during the Winter General Meeting, it was thought desirable to hold a conference on feedback control systems during 1953. A committee was appointed at that time to look into the possibilities of holding such a conference. It was decided that the proposed conference should stress the practical aspects of feedback control systems engineering, since previous conferences have stressed and rather thoroughly established the theoretical aspects. In keeping with the practical emphasis, it was thought desirable to exhibit equipment used in and resulting from feedback control systems engineering at the proposed conference.

COMMITTEE ON GENERAL INDUSTRY APPLICATIONS

Machine Tool Subcommittee's fifth annual technical conference was very successful and well attended. This conference was held in Albany, N. Y., October 29–31, 1952. Registration at the conference was approximately 400 engineers from various machine tool industries. In accordance with the subcommittee's long-range plan, the next annual conference will be held in Cleveland, Ohio, followed the next year by a meeting in Detroit, Mich.

Materials Handling Subcommittee contributed a session on the subject of elevators and escalators to the Winter General Meeting.

Pulp and Paper Subcommittee remained inactive, and may be dropped.

Rubber and Plastics Subcommittee met with such great success in holding its fourth annual technical conference in 1952 that a 2-day session was planned for 1953. Registration at the conference, April 28, 1952, in Akron, Ohio, was approximately 200 engineers and executives of rubber and plastics industries. The 1953 conference was held April 20–21. The proceedings of both the third and fourth annual technical conferences, including discussions, are now available in the form of a booklet published by the Institute. It is planned to continue to publish the proceedings each year for the benefit of engineers who wish occasionally to refer to the papers or discussions.

Textile Subcommittee added to its customary schedule of two annual technical conferences, a third technical conference in Raleigh, N. C., November 6–7, 1952. A full program of technical sessions, inspection tours of the Engineeering Research Laboratories and School of Textile Laboratories of North Carolina State College was the basis for a very successful meeting. Attendance of more than 200 was the largest yet for a textile conference. In Philadelphia, Pa., April 24, 1952, the Northern Technical Conference jointly sponsored by the Textile Subcommittee, the AIEE Philadelphia Section, and the Philadelphia Textile Institute was presented before an attendance of about 65. The 1953 annual northern conference was held May 1, in conjunction with the North Eastern District Meeting. The southern conference, jointly sponsored by the Textile Subcommittee, The A. French Textile School, and the School of Electrical Engineering at the Georgia Institute of Technology, Atlanta, was held May 1–2, 1952, with an attendance of 162. A similar conference was held at Georgia School of Technology, April 23–24, 1953.

A major project extending over a period of several years has been that of discussion and determination of what is a suitable enclosure for industrial control equipment and similar devices used in the linty areas of textile mills. The subcommittee has proposed purely functional requirements for the enclosures and has publicized these in textile periodicals, with a request for comments. These proposals were also discussed and balloted upon at each textile conference. A joint AIEE–NEMA committee on textile mill control enclosures has been formed to consider the enclosure specifications and the results of balloting at textile conferences. Although no positive action has been taken, results to date are improved designs of NEMA Type *1-A* enclosures being offered by certain manufacturers for textile applications. The modifications to the NEMA Type *1-A* are mostly features that would be desirable in many other industries as well as textiles. It is entirely possible that this improved design could be adopted by a group of industries, including textiles, as a "general industry control enclosure."

General. The committee as a whole sponsored two technical sessions, one at the Fall General Meeting, and one at the Winter General Meeting. A serious problem facing this committee is the question of distinguishing between subjects for papers that are of general interest to industry as a whole and which may be logically presented at a General meeting, and subjects which merely pertain to a single industry and would not attract sufficient interest at a General meeting, but would be appropriate for a special conference. The committee and subcommittees are trying constantly to improve the method of classifying subject matter and scheduling papers.

COMMITTEE ON INDUSTRIAL CONTROL

The committee held two meetings during the past year: one in Cleveland, Ohio, October 1, 1952, and the second in New York, N. Y., January 21, 1953.

At the Winter General Meeting, the Committee on Industrial Control sponsored two technical sessions, one on the general subject of the co-ordination of control with industrial power systems, and the other on the general subject of packaged-drive design and problems. Both of these sessions were very well attended and stimulated considerable discussion from the floor.

At the January meeting of this committee, it was decided to sponsor one or two technical sessions during the 1954 Winter General Meeting. It is the hope of this committee to present sessions on the general theme of the steel industry on the East Coast. These sessions may be jointly sponsored with the Committee on Mining and Metal Industry.

Following are the reports of the various subcommittees:

Subcommittee on Test Codes has prepared two tentative drafts of test codes which are now being reviewed by many of the members of the Committee on Industrial Control. These test codes cover procedures for conducting temperature-rise tests on resistors, rheostats, and their assemblies, and also for conducting continuous and 8-hour temperature-rise tests on a-c and d-c controllers.

Subcommittee on Bibliography is working with the corresponding subcommittee of the Committee on Feedback Controls in the preparation of a bibliography on feedback control. It is expected that this bibliography eventually will cover approximately 1,000 items. Portions of this bibliography will be submitted as a *Transactions* paper as part of the program of the Committee on Feedback Control Systems.

Subcommittee on Electronic Control has organized three task forces for the purpose of preparing standards on electronic controls for d-c motors, standards for photoelectric systems for use in register controls, and standards for photoelectric relays.

Subcommittee on Regulators and Feedback Control Systems is working with the Committee on Feedback Control Systems for the purpose of co-ordinating the work being done on symbols and terms to be used in feedback control systems.

COMMITTEE ON INDUSTRIAL POWER SYSTEMS

Subcommittee on Distribution Systems in Industrial Plants has reorganized the work of revising the "Redbook," and it is anticipated that this revision will be completed within the next year. Because of the delays, the intent now is to make very extensive revisions and rearrangement of the "Redbook" ("Electric Power Distribution for Industrial Plants"). In addition to rearrangement some additional information concerning the application of relays in industrial power system circuits will be included. The revision has been severely handicapped by the shortage of engineering manpower prevalent in the electrical industry. It is hoped that the present program can be carried out as planned.

Subcommittee on Distribution Systems in Commercial Buildings is reviewing the "Green Book" ("Interior Wiring Design for Commercial Buildings") to determine whether revision is required at the present time. It is anticipated that the "Green Book" will be reprinted some time in the near future, either in its present form or with revisions.

Subcommittee on Grounding is continuing its review of the problems and methods of grounding power systems, equipment, and structure in industrial plants. Several papers on this subject have been sponsored by the committee. The subcommittee is working toward a report to serve as a guide for grounding practices in industrial plants.

Subcommittee on Codes and Standards is getting well organized, and expects to take an active part in the formulation of codes and standards that affect the installation and operation of electric power systems in industrial plants. It is the intent that this subcommittee will represent the industrial viewpoint in the formulation of codes and standards affecting the electrical industry.

This subcommittee co-operated with the Committee on Insulated Conductors in sponsoring a conference on aluminum conductors at the 1952 Fall General Meeting. This conference was very well attended and a great deal of interest was shown in the question of using aluminum conductors, both in industrial power systems and in utility systems. The papers presented are to be published in booklet form to provide reference material on the use of aluminum conductors.

General. The members of the Committee on Industrial Power Systems are very much interested in the question of the publication of papers presented not only at technical sessions, but also at conferences at the General meetings. While there are certain limited channels for distributing information on electric system questions and problems within some industries, there is no general industry-wide channel of communication among the electrical engineers concerned with industrial power systems. For this reason, the members of the committee are strongly in favor of some means for communication of electric system information concerning industrial practices. Many of the industrial electrical engineers strongly favor some means for distributing, or at least indexing, conference papers presented in industrial power systems sessions. For this reason, the committee has undertaken to list, for reference purposes, all of the papers presented at the industrial power systems sessions in recent years.

COMMITTEE ON MINING AND METAL INDUSTRY

The present Committee on Mining and Metal Industry was organized in 1947, and held its first group of sessions at the Winter General Meeting in Pittsburgh, Pa., January 1948. As of the date of this report, the committee has sponsored 26 sessions and presented 107 papers.

During the past year, the committee reorganized its structure in order to expand its activities to include: (1) promotion of technical papers; (2) organization of round-table discussions and conferences; (3) preparation of committee progress reports or special publications; (4) promotion and organization of special technical conferences; and (5) sponsorship of work or studies leading to standards.

A planning group selected from the committee membership prepared guides to be used by the chairman of each of the three subcommittees in making assignments to the members of his subcommittee. The three subcommittees are the Eastern Mining Subcommittee, the Western Mining Subcommittee, and the Metal Industries Subcommittee.

The Eastern Mining Subcommittee is very actively engaged in preparing a program for the Middle Eastern District Meeting in October 1953. The subcommittees also are planning sessions for the Pacific General Meeting, the Fall General Meeting, and the Winter General Meeting.

Power Division

COMMITTEE ON CARRIER CURRENT

The Committee on Carrier Current sponsored technical sessions at each of three General meetings of the Institute held during the past year, and plans have been completed for a further technical session during the 1953 Summer General Meeting.

The members of the committee met during the 1953 Winter General Meeting, and will meet again during the 1953 Summer General Meeting.

Progress in the work being carried out by the committee is detailed in the following subcommittee reports:

Executive Subcommittee. This subcommittee functioned at the various General meetings of the Institute and at an additional meeting in New York, March 19 and 20, 1953.

Subcommittee for Preparation of a General Interest Paper on Carrier Current. The report of this subcommittee, "The Evolution of Power-Line Carrier," has been ready for some time. During the past year, a further paper, "Power-Line Carrier and Microwave Applications in Power System Operation," was completed by the committee. Publication of these articles in *Electrical Engineering* is proposed.

Subcommittee to Report on Application Guidance for Carrier Current. All of the main sections of the "Application Guide," with the exception of the section on line tuning, have been completed. It is proposed to present this committee report as a basis for discussion at the Symposium on Carrier Current and Microwave to be sponsored by the committee during the 1953 Pacific General Meeting, the details of which are outlined in this report.

Subcommittee on Methods of Measurements and High-Frequency Characteristics of Power Equipment and Transmission Lines. The original presentation of this group, "Methods of Measurements at Carrier Current Frequencies," has been extensively revised, and it is planned to use it as an introduction leading to the solicitation of field data. Under preparation, at the present time, is the revision of the standard data forms for solicitation of field data and a standard method for graphical presentation of these data, together with a list of those pieces of apparatus on which information is needed. It is expected that all of this will lead ultimately to the preparation of a field test manual. Much of the work is on the basis of long-range planning, which is essential to avoid any possibility of wasted effort.

Subcommittee on Use of Microwave Equipment for Relaying, Telemetering, and Supervisory Control. The work of this subcommittee has been concentrated in the direction of promoting technical papers covering microwave equipment and its application. It is planned to continue this type of activity, with particular emphasis at the present time on the 1953 Pacific General Meeting.

Subcommittee on Operating Experience With Carrier-Current Relaying Channels. "Experience and Reliability of Carrier

Relaying Channels," the report of this subcommittee, has been submitted for the 1953 Summer General Meeting. This presentation is based on replies to questionnaires from 33 power companies covering 206 line sections and representing a good geographical distribution of the United States. It is considered that this information will be of use to the power industry as a guide and for reference purposes.

Subcommittee to Study Long-Life Tubes. It is the opinion of this subcommittee that any revision of its report of June 9, 1952, (which was distributed to committee members only) to make it suitable for presentation as a committee report, would serve no further useful purpose. This is due to continuing changes in the electron tube industry. Thus, the listing of tubes or tube complements used in carrier-current equipment is certain to be out-of-date before it is published.

For its future work, it is planned to obtain data on tubes applicable to carrier-current equipment, particularly with respect to usage conditions such as voltage and temperature fluctuations, and methods and frequency of tube testing practices.

The name of this subcommittee will be changed to "Subcommittee on Electron Tube Applications," which is more descriptive of its present work.

Subcommittee to Prepare a Carrier-Current Bibliography. The "Bibliography of Power-Line Carrier Literature," covering the period 1933–49, was presented as a committee report at the 1953 Winter General Meeting. This subcommittee will be continued, and a revised title for the bibliography, to cover the entire scope of the committee, will be taken into consideration.

Subcommittee on Standards for Carrier Radiation. The purpose of this newly formed subcommittee is to prepare standards for carrier radiation, so that they may be used in consideration of FCC proposals, and, in particular, Docket number *9288*. Any conflict with the activities of other committees which becomes apparent as the work of this subcommittee progresses will be dealt with through the appointment of liaison representatives.

Other Activities. Considerable thought and effort have been given to the Symposium on Carrier Current and Microwave to be sponsored by the Committee on Carrier Current during the 1953 Pacific General Meeting. Tentatively, the date has been set for all day Wednesday, September 2, 1953.

During the morning a committee report entitled "Application Guide for Carrier Current" will be presented as a basis for discussion on the subject of carrier current. Similarly, in the afternoon, the discussion on microwave will be introduced by the presentation of a committee report on "Installation and Operating Experience With Microwave for Power System Operation." Ample time will be available following each report for a question and answer period, and each session will be presided over by a chairman and group of advisors qualified to give expert advice on the problems presented.

It is hoped that this type of conference will stimulate interest in the use of these important services for power system operation, and that those engaged in all phases of the power field will avail themselves of the opportunity to become more fully acquainted with present techniques and applications and the latest in carrier current and microwave developments.

COMMITTEE ON INSULATED CONDUCTORS

The Committee on Insulated Conductors is organized into 12 subcommittees: Administration, Standards and Publications, Cable Characteristics, Conductors, Insulations, Sheaths and Coverings, Cable Supply Systems, Utilization Wiring Systems, Special-Purpose Cable, Accessories, Structures, Tests and Measurements. These subcommittees are all very active in their assigned fields, and from their titles it can be seen that the work covers all phases of the cable field. The basic work of the committee during the fiscal year was carried on at two general meetings of all of the subcommittees, which were held in New York, N. Y., and Pittsburgh, Pa. The work of the committee resulted in the sponsorship of sessions at each of three AIEE General meetings.

During the past year, the question of using aluminum in place of copper, because of the availability factor or economic considerations, has received considerable attention. Realizing the importance of this development, the Committee on Insulated Conductors and the Committee on Industrial Power Systems jointly sponsored an all-day session on insulated aluminum conductors at the Fall General Meeting. Nine conference papers were presented and, as a consequence of the interest which developed in these papers, it has been decided to have them printed as a special publication.

Some of the many important subjects which the various subcommittees have under consideration are exemplified by the following:

Standards and Publications Subcommittee. A bibliography of the major technical articles on insulated conductors is being prepared, and considerable thought has been devoted to setting up the format and the method of classifying the material. Tabulations have been prepared and will be fitted into the system.

Cable Characteristics Subcommittee. One of the many studies being carried on is the investigation of the thermal resistivity of the soil. An important aspect in dealing with soil thermal resistivity is the question of instability under certain conditions, which apparently are related to the phenomenon of moisture migration. Data are being obtained on this subject, and consideration is being given to obtaining sponsorship for further research work in this field.

Cable Supply Systems Subcommittee. Developments in high-voltage cable systems are followed closely, and plans are being prepared for the presentation of a group of papers covering installations representing the latest types of high-voltage cable.

Accessories Subcommittee. The use of limiters in low-voltage cable systems plays an important part in the satisfactory operation of such systems. A working group is actively engaged in the preparation of standards relative to the use of limiters.

Structures Subcommittee. Under the sponsorship of this group, a symposium is being planned, including papers on marine and viaduct crossings.

COMMITTEE ON POWER GENERATION

During the year, this committee held a meeting at each General meeting of the Institute. A number of sessions were sponsored at the General meetings, some of which were joint sessions with other committees. In addition to the scheduling of papers, reports were submitted on investigations into subjects such as the need for research in the power generating field and the application of probability methods to power system problems. The activities of subcommittees may be summarized as follows:

Prime Movers. This subcommittee continued to study the present-day trends in design of electric generating prime movers of all types, including the gas turbine. Growing national demands are leading to providing units of increasing size.

Station Design. During the past year, the principal activity of this subcommittee was a general review of the design and operation of modern powerhouse auxiliary systems and auxiliary drives. A total of four technical sessions on this subject were sponsored, some jointly with the Subcommittee on Induction Machinery. The rapid increase in unit sizes has caused some interesting changes in station service philosophy. A new undertaking of the subcommittee is a study of practices and requirements for boiler protection. The ultimate aim is to develop a committee report outlining recommended practices. A symposium and round-table discussion on boiler protection is planned for the Summer General Meeting. Items which the subcommittee plans to investigate in the future include power plant economics and miniature control boards.

Speed Governing. This subcommittee co-operated with the Control Subcommittee of the Committee on System Engineering in the joint sponsorship at the 1953 Winter General Meeting of two sessions on system load control and frequency regulation. The subject matter presented and discussed included progress in governor performance; means for handling unique and rapid load fluctuations; general system control; economic loading of stations together with contributions from ASME members on problems associated with the control of high-temperature, high-pressure, and reheat steam generators. During recent years, governors in general have been manufactured to perform even better than required by the joint AIEE-ASME governor specifications. In most areas, sufficient new generation with modern governors has been installed to give reasonable speed governing of the system. The basic problem now is one of providing adequate supplementary correction to control frequency, tie-line loads, time, and at the same time give economic distribution of load between stations. A session is being planned, probably for the Fall General Meeting, on turbine controls and their relation to station and system operation.

Hydroelectric Systems. The subcommittee has expanded its membership considerably during the year in order better to

deal with the increasing tempo of advances in the hydroelectric field.

Such outstanding developments as the placing in service of two very similar outdoor hydroelectric power stations in northern Quebec, thus extending very much further north this design technique; the driving of the two largest power tunnels ever built in North America, to serve the Sir Adam Beck Station of the Hydro-Electric Power Commission of Ontario, which tunnels are 51 feet rough diameter and 45 feet finished diameter; the Hiwassee pump-turbine unit of Tennessee Valley Authority, with a 58,000-kw capacity as a turbine and pumping 4,000 cubic feet per second against a static head of 205 feet; and many other interesting developments and redevelopments; all indicate a very active period technically in the hydroelectric field.

Excitation Systems. Since the very beginning, the development of the regulated excitation system has been motivated by the desire to obtain an increased reliability, reduced maintenance, and improved performance. Within the last few years, the use of the modern static-type voltage regulator, in conjunction with the rotating amplifier, provided an excitation system of great merit in almost every respect. Nevertheless, the operating experience and analysis of many tests indicated that further improvements are desirable.

In a recent paper before the Institute, it was disclosed that a system is available which should permit even a closer approach to the ideal excitation system. Instead of the rotating amplifier, a static, multistage magnetic power amplifier is used in conjunction with the static voltage regulator. The laboratory tests and analysis of such an excitation system indicate an improvement in performance, while the anticipated increase in reliability and the decrease in maintenance will have to be confirmed by the operating experience.

With the present trend to lower short-circuit ratio of modern turbogenerators, it is vitally important to have an excitation system capable of achieving the ultimate response from the exciter. It appears that the recent development should fill this need.

Pacific Coast. The committee has devoted considerable attention to the many recent failures of thrust bearings in large vertical hydroelectric units on the Pacific Coast. Data are being collected and studies made of the performance of various bearing alloys, shoe support structures, and lubricating oils. The use of high-pressure oil for starting also is being considered.

Generator insulation testing with high-voltage direct current is gaining in popularity, and studies are being made to determine the best methods and procedures.

There is a growing tendency to use a single organization for the operation and maintenance of the newer steam-electric generating stations, with the same men handling both the mechanical and electric apparatus. This appears to be more satisfactory than the dual organizations formerly used.

Application of Probability Methods. This subcommittee is preparing a preliminary report on the outage data of high-pressure turbines and boilers for the years 1951 and 1952. This report will be presented at the Summer General Meeting. The collection and analysis of data on high-pressure turbines and boilers will be continued until stable values are established for the outage rates of these units.

The subcommittee is still greatly interested in the preparation of a manual co-ordinating the work of various authors on the subject of the determination of reserve capacity by the probability method, and is seeking a person or company willing to undertake and carry through the project.

Recommended Specifications for Prime-Mover Speed Governing. The draft of a specification for the speed governing of internal combustion engine-generator units has been completed, and, except for minor editorial changes and additions, is substantially in final form requiring only the insertion of certain numerical performance values for completion.

The joint committee has approved in principle the draft of the specification in order that the subcommittee may have a basis for the solicitation of funds to meet the cost of a comprehensive test program to determine the necessary performance values for insertion in the specification. The ASME has agreed to act as custodian of the funds to be raised, and the Battelle Memorial Institute has been engaged to conduct the necessary tests. This test program may require a period of 2 years for completion.

The joint committee also has co-operated with the ASME Power Test Code Committee Number *20* in the preparation of a code for the testing of speed-governing systems of steam prime movers. It is expected that this test code will be completed before the end of the current calendar year.

COMMITTEE ON PROTECTIVE DEVICES

The Committee on Protective Devices sponsored a technical session at the Winter General Meeting, and, jointly with the Committee on Power Generation, sponsored a technical session at the Fall General Meeting. It held committee meetings in May 1952 and during the 1953 Winter General Meeting. Holding one committee meeting at the time of a General meeting and the other at a time apart from a General meeting is believed to balance the needs of West Coast members who find it advantageous to attend a General meeting and a committee meeting in one trip, and the need of other members who prefer to devote more time at the General meetings to technical sessions. The activities of the committee are primarily carried on by three subcommittees:

Fault Limiting Devices Subcommittee, through its working groups, has been actively engaged in revising the three application guides: (1) Guide for the Application of Ground-Fault Neutralizers, (2) Application Guide for the Grounding of Synchronous Generator Systems, and (3) Application Guide on Methods of Neutral Grounding of Transmission Systems. These guides originally were issued in 1949, and have been available since that time on a trial basis. They have been approved by the Fault Limiting Devices Subcommittee and the Committee on Protective Devices and the first two were presented at the 1953 Winter General Meeting. The third guide will be presented as a technical paper at the Summer General Meeting. All three guides have been forwarded to the Standards Committee for approval and publication as "Guides."

Another working group has been studying and reviewing the factors relative to the necessity for shunting protective devices on reactors used in feeders and neutrals. Two questionnaires covering reactor applications have been sent to the users, but no definite conclusions have been revealed by these questionnaires. It appears that very little reactor trouble has occurred in service. This working group plans to continue its study, concentrating on possible troubles in cable circuits. A transient analyzer investigation will be a part of this study. A working group has been organized to study methods of reduction of ground resistance, and liaison is also maintained with the Committee on Substations by means of a representative assigned to its working group on a Guide for Substation Grounding Practices. Another working group is in process of organization to revise Standard Number *32*, Neutral Grounding Devices.

Lightning Protective Devices Subcommittee. During the past year the following projects have been completed:

1. Revision of "Performance Characteristics of Lightning Arresters," presented at the Winter General Meeting, and including up-to-date characteristics based on revised tolerances specified by NEMA Lightning Protective Devices Section.
2. Survey covering "Direct Stroke Protection of Substations and Stations," presented as a conference paper at the Winter General Meeting, and based on replies received from 47 operating companies as to operating experience and present and future practices regarding shielding.

Other activities of the subcommittee covered the following projects:

1. Revision of "Combined Standard for Valve and Expulsion Arresters," AIEE Number *28-A*.
2. Lightning Arrester Application Guide for the Protection of Substations and Stations.
3. Lightning Protection of Aerial Cable.

In connection with the revision of the "Combined Standard for Valve and Expulsion Arresters," additional data have been and are being obtained regarding long-duration surge tests, change of power factor requirements of the test circuit for expulsion-type arresters, and change of arrester designations. Consideration is being given to the need for a change of 10×20 current wave tests now specified in the standards.

A report of the Working Group on Lightning Arrester Application Guide for the Protection of Substations and Stations has been completed after many 2-day meetings of the group. The guide includes the latest engineering considerations, reconciles some of the differences of opinion as to application of protective devices, and, in general, makes available to the industry a wealth of material which should be of outstanding value to application engineers and operating personnel.

Preliminary considerations by the Working Group on Lightning Protection of Aerial Cable disclosed that there is a definite need for information pertaining to the protection of aerial cable and connected equipment. A questionnaire is being prepared for circulation to operating companies to obtain details regarding operating experience and lightning protective practices.

Insulation Co-ordination Subcommittee acts in a liaison capacity between the Committee on Protective Devices and Standards Co-ordinating Committee Number *8*. This latter committee has been active during the year attempting to establish an array of BIL's above 1,050 for system voltages above 230 kv. This work has included the establishing of the concept of a nominal and a maximum design voltage for apparatus which are 5 per cent apart. Also, work has been done on the minimum acceptable transformer low-frequency test voltages and the close relationship between these test voltages and impulse test voltages. For progress in this undertaking, reference should be made to the AIEE Number *8* Committee on 1952 activities.

COMMITTEE ON RELAYS

This committee held three meetings, and sponsored five technical sessions, one jointly with another committee. The technical activities of this committee were carried on through a number of project committees which were appointed to fulfill specific assignments. One new project committee, on protection of generators on unbalanced current, was added. Also, the Pacific Coast Subcommittee was organized to increase the interest and co-operation of Pacific Coast members. Following are the reports of the various project committees:

Bibliography of Relay Literature. Work on the "Relay Bibliography for 1950" has been completed. Publication is expected during 1953. The committee will continue to maintain an up-to-date bibliography.

Remote Tripping Schemes. This project committee practically completed its assignment with the presentation of its final report at the Winter General Meeting.

Standards for Power Relays. This committee now is engaged in developing general performance requirements of power relays. The initial, and perhaps most difficult, phase of this work involves inverse-time overcurrent relays, and particularly their time-current characteristics. An attempt will be made to standardize on a minimum number of curve shapes and on a single type of co-ordinate paper for plotting time-current curves. To avoid duplication of effort, the committee is following closely the standardization activity of NEMA and a study being made by the Pennsylvania Electric Association.

Transmission-Line Protection. The preparation and presentation of papers on ground relaying and backup relaying have completed the list of papers which are to be published in a brochure on the general subject of transmission-line protection. Publication of this brochure, probably within the next year, will complete the assignment.

Electronic Relay Applications. This committee will continue to follow the developments in this field. A report will be available shortly on the operating experience obtained with an installation of electronic distance relays.

Co-ordination of Relay Protection of Industrial Power Systems With Utility Systems. This committee is continuing its program leading to industrial management's greater consciousness of the need for well-engineered relaying and the benefits to be derived from it. Work is progressing rapidly on a chapter on relaying for the AIEE "Red Book" ("Electric Power Distribution for Industrial Plants").

Effect of Vibration and Shock on Relays. After 2 years' study of the problem, supplemented by laboratory and field tests by several members of the committee, some progress can be reported; but because of the complicated nature of the problem, and lack of information and data on the subject, the committee does not consider its work completed. A summary of progress has been prepared and circulated among members of the main committee. Independent, although co-ordinated, investigations will be made by the Pacific Coast Subcommittee through the University of Washington and the Bonneville Power Administration.

Test Methods. This committee is continuing its work on the formulation of standard testing procedures.

Pilot Wires. This project committee practically completed its assignment with the presentation of its final report at the Winter General Meeting.

Protection of Generators on Unbalanced Current. This new committee already has sponsored a technical session, with papers rather completely covering the subject. Although some work remains to be done, completion is expected within the next year.

Pacific Coast Subcommittee. This committee already has begun to justify its existence by (1) co-operating with the various project committees, (2) sponsoring a relay session at the Pacific General Meeting, and (3) initiating independent work of interest in the area.

Joint and Associated Projects. The committee participates in the activities of the Instrument Transformer Subcommittee of the Committee on Transformers, and has maintained close co-ordination with the activities of the Committee on Carrier Current on items of joint interest. Also, the Committee on Relays is participating with the Committee on Transmission and Distribution and with the Edison Electric Institute Transmission and Distribution Committee on the project "Co-ordination of Construction and Protection of Distribution Circuits." This group is analyzing data for the years 1950 and 1951 obtained from approximately 20 companies.

COMMITTEE ON ROTATING MACHINERY

Major attention of this committee has been focused on standards relating to rotating machinery. Serious attempts were made to take a more active role in the formulation or revision of ASA standards bearing AIEE approval; these included *C-50*, *C-42*, *C-6*, and others. More general recognition now is being given to the need for better co-ordination between the activities of AIEE representatives on ASA committees and the cognizant technical committees. This committee is trying seriously to improve its own effectiveness in that field.

Technical activities, in the form of papers and sessions, continues at a high level.

Some concern is felt by the committee over the reported reduction in, or discontinuance of, electric machinery courses by some of the leading educational institutions.

Insulation Subcommittee. The Subcommittee on Insulation sponsored two sessions on various types of electric machinery insulation subjects during the last year. Emphasis at the recent Winter General Meeting was placed on papers relating to functional evaluation of insulation systems. The subcommittee also has three active working groups: (1) Working Group on Preparation of Insulation Maintenance Guide for Large A-C Rotating Machinery; (2) Working Group on Evaluation of Insulation Systems for Random Wound Electric Machinery; and (3) Working Group on Voltage Endurance Studies on Rotating Machinery. The first working group has completed the preparation of the Insulation Maintenance Guide and has submitted it to the Committee on Rotating Machinery for approval. The second working group has completed a proposed test code for the evaluation of systems of insulating materials for random-wound electric machinery. This test code also has been submitted to the Committee on Rotating Machinery for approval. The third working group is still in the process of developing information on voltage endurance, and the investigational work is being carried out at the California Institute of Technology. It is hoped that the maintenance guide and the test code eventually will be approved for publication for trial use by both the Committee on Rotating Machinery and the Standards Committee.

Induction Machinery Subcommittee. Unusually good interest in this subject is reflected by the large number (22) of papers sponsored. A very successful all-day symposium on the design of double-cage rotor motors was conducted at the Middle Eastern District Meeting. Plans are being made for a similar symposium this fall at a technical conference to be held in Fort Wayne, Ind.; this will be on a different phase of induction-motor design. The revised Test Code for Polyphase Induction Machines was approved by the AIEE Standards Committee, but failed to gain approval of the ASA *C-50* Sectional Committee. Further work on the part of the working group that drew up the revision will be required to reconcile the differences. A full session is planned for the 1954 Winter General Meeting.

D-C Machinery Subcommittee. At the Winter General Meeting, the D-C Subcommittee sponsored a symposium on maintenance of rotating machinery. So far as is known, this was the first time a session of this kind has been carried out by a rotating machinery subcommittee. Much interest was shown in the four conference papers that were presented. This meeting was attended by 110 people. It is very probable that the maintenance meetings will be continued.

At another session at the Winter General

Meeting, five *Transactions* papers were presented around the subject of "Transient Performance of D-C Machines." Much interest was shown in this very timely subject.

Three meetings of the committee were held to plan work for this year and for the coming year. The committee will sponsor two sessions at the Winter General Meeting, and possibly a session at another General meeting.

Table I for ASA *C-50* has been revised and accepted for publication. Other sections of ASA *C-50* have been reviewed by the committee. Also, review has been made of ASA *C-42*.

Single-Phase and Fractional-Horsepower Subcommittee. There is a pronounced trend toward reduction of motor frame sizes for all fractional-horsepower ratings, principally accomplished by improving ventilating systems. There has been some change to the use of new winding insulation materials and new lead covering materials, in general in the direction of greater dielectric strengths. A number of manufacturers are providing motors with internal switches which adapt the motors particularly to electric clothes dryers.

A special technical conference on fractional-horsepower motor applications is planned for Fort Wayne, Ind., in October 1953.

A working group has been set up to revise the Test Code for Single-Phase Motors.

Synchronous Machinery Subcommittee. Sessions were sponsored at both the Summer and Winter General Meetings. The session at the Winter General Meeting was a joint session with the Committee on Relays. The subcommittee sponsored three papers on the general subject of the effects of unbalanced faults on machines, while on the same day the Committee on Relays had a session on the problems involved in relaying for the same type of faults.

Work is progressing slowly on the operating guide for generators. Recent changes in the method of cooling hydrogen-cooled turbine-driven generators have complicated the work of preparing an operating guide, but the subcommittee has agreed to continue the work of preparing this guide and plans to increase the effort put upon it.

Electric Couplings Subcommittee. Two papers were sponsored in Minneapolis, Minn., and one in New York, N. Y. The bibliography, prepared last year, has been printed. This subcommittee is actively working on definitions of items used in rating electric couplings. A full technical session is planned for January 1954.

Publicity and Bibliography Subcommittee. The activities of the Publicity and Bibliography Subcommittee during 1952 consisted of preparing notes on the activities of the Committee on Rotating Machinery during the year for publication in *Electrical Engineering* from time to time, and the "1952 Engineering Developments" in rotating machinery for the January 1953 issue of *Electrical Engineering*.

Test Code Subcommittee. Two members are serving on the Master Test Code for Rotary Speed Measurements Subcommittee of the Committee on Instruments and Measurements. Eventual revision of all test codes is anticipated.

Working Groups. Three working groups were set up last year:

1. *Per-Unit Definitions.* This group has met a number of times and engaged in much discussion without coming to any general agreement. It still is carefully optimistic.

2. *Letter Symbols for Induction-Motor Quantities.* This group has met a few times, and has made considerable progress in setting up proposed standard letter symbols for the network constants of single-phase and polyphase induction motors. Use of standard symbols by authors would greatly facilitate reading and reviewing of future technical papers.

3. *Co-operation With Engineering Schools.* Work of this group is now temporarily arrested by lack of a chairman, but the need for this activity is felt.

COMMITTEE ON SUBSTATIONS

Automatic and Supervisory Control. A questionnaire on supervisory control and telemetering has been sent out. The group plans to work with the Subcommittee on Telemetering on the revision of the 1948 telemetering, supervisory control, and associated circuits reports.

Device Function Numbers. This group is working with ASA *Y32/2* Task Group on Designations. ASA *C37.2* soon will require review.

One-Line Diagrams. This group has prepared a paper on Substation 1-Line Diagrams and completed its assignment.

Location and Design of Distribution Substations in Residential Areas. A working group has been established to study this problem and prepare a report.

Circuit Breakers Versus Reclosing Fuses. This group has prepared a report on the present use and trends of circuit breakers, automatic circuit reclosers, and reclosing fuses to be presented at the Summer General Meeting.

Recommended Minimum Clearances. This working group has almost completed a guide on recommended minimum clearances in substations.

Safety Considerations in Substations. A guide is being prepared by this working group for early presentation.

Substation Grounding Practices. The preliminary work on this subject has been completed by the group, and a final guide will soon be available.

General. The Committee on Substations sponsored two joint technical sessions at the Winter General Meeting, and will sponsor a technical session at the Summer General Meeting. Two committee meetings were held.

COMMITTEE ON SWITCHGEAR

The Committee on Switchgear held two meetings during the past year. It sponsored technical sessions at the Summer, Fall, and Winter General Meetings.

The work of the committee is generally carried out in several subcommittees. The committee has co-operated with Standards Co-ordinating Committee number *4* by providing representatives to assist in the study and preparation of the "Report on Temperature Correlation in the Connection of Insulated Wires and Cables to Electric Equipment." This report has been approved by the Standards Committee, and is available as a regular AIEE report.

Administrative Subcommittee. The Administrative Subcommittee has served the functions of the several subcommittees and the Committee on Switchgear by co-ordinating the work in these several groups and by providing a session where the chairman, secretary, and subcommittee chairmen might consult regarding their administrative problems before each meeting of the Committee on Switchgear. The subcommittee has been of great assistance in establishing matters of policy and in encouraging various programs of activity in the several technical subcommittees. This subcommittee should be a continuing part of the committee organization.

Power Circuit Breaker Subcommittee. One of the outstanding assignments in this subcommittee is that of preparing a new method for rating power circuit breakers. This study which is being done by the Working Group on Circuit Breaker Rating Methods involves the preparation of all changes necessary in the present ASA Standards *C37.4*, *C37.5*, and *C37.9* which would be necessary to adopt the Symmetrical Method of Rating, as proposed by the IEC. This work is now well along and may be completed by 1954.

The subcommittee has recommended and the Committee on Switchgear and the Standards Committee have approved the following items, to supplement the revision of the present Standards *C37.4*, *C37.5*, and *C37.9*, these having been transmitted to ASA for adoption during the year 1951–52:

1. Recommendation that AIEE paper 48–258, "Simplified Calculation of A-C Short-Circuit Currents," be added as a separate section to ASA *C37.5*.
2. Adoption of temperature rise of 35 degrees centigrade for contacts of oilless power circuit breakers.

In addition, the subcommittee is working on:

1. The application of generator neutral circuit breakers.
2. Duty-cycle changes for high-voltage power circuit breakers.
3. Breaker duty when interrupting phase to ground short circuits; and other similar problems.

Low-Voltage Air Circuit Breaker Subcommittee. A letter ballot has been completed to make the following changes in AIEE Standard number *20*:

1. A paragraph to be inserted to state that Standard number *20* does not apply to molded-case circuit breakers.
2. The temperature rise for silver-surfaced contacts and terminals of low-voltage air circuit breakers was set at 40 degrees centigrade.

The revised Standard number *20* on low-voltage air circuit breakers, which has been approved by the Standards Committee, has been referred to ASA, together with an Application Guide and Test Code which

had been previously completed. It is expected that these, with other sections, soon will form an ASA Standard on low-voltage air circuit breakers.

The subcommittee is investigating the desirability of preparing AIEE Standards for molded-case circuit breakers. At the present time the manufacture of these breakers is covered by specifications from other organizations.

The subcommittee has accepted a new assignment to prepare a "Guide for the Calculation of Short-Circuit Currents on D-C Systems and the Application of Air Circuit Breakers on D-C Systems."

Switches, Fuses, and Insulators Subcommittee. This subcommittee has in the past year completed work on Standards numbers *22* and *25*. These Standards have been reprinted. At present the subcommittee is actively engaged on the following subjects: (*a*) interrupter switch definitions, (*b*) guide for the operation and maintenance of fuses and switches, (*c*) guide for ice testing of disconnecting switches, (*d*) co-ordination of switch through-current ratings with circuit breaker through-current ratings, (*e*) standard for temperature test, (*f*) dew flash-over values, (*g*) insulating nomenclature, (*h*) interrupter switches for starting and stopping large auxiliary motors, (*i*) symmetrical versus asymmetrical ratings of equipment, and (*j*) exploratory investigation of need for standards on fuses—600 volts and below.

Automatic Circuit Reclosers Subcommittee. This subcommittee has completed work on revisions of AIEE Standard number *50*, which have been approved by the Standards Committee and reprinted.

The subcommittee now is actively engaged in determining the need of standards for automatic line-sectionalizing switches. Line sectionalizers are finding quite extensive use in some distribution systems. It was thought by the subcommittee at its January 21, 1953, meetings that standards for this type of equipment should be formulated.

The subcommittee also is considering the need of standards for capacitor switching devices for distribution circuits. This is a subject requiring an appreciable amount of theoretical study and gathering of field experience. It is expected that a report on this item will be made at the next meeting of the Committee on Switchgear.

Switchgear Assemblies Subcommittee. Since the revision of AIEE Standard number *27*, which was accomplished last year, this subcommittee has concerned itself mainly with the problem of solar heating in outdoor metalclad switchgear, its magnitude, method of measurement, and basis for application of necessary cooling or ventilation so that the different factories might proceed with their experimental investigations.

Special tests have been conducted on installed switchgear in various sections of the country, and careful consideration is being given to the effects of winds, position of switchgear mounting with respect to the path of the sun, and other such items which affect the temperature inside outdoor metalclad switchgear housings.

Network Protector Subcommittee. This subcommittee has remained inactive during the year awaiting the results of work being done by the Edison Electric Institute (EEI)–NEMA Joint Committee on Network Transformers. This work is being done directly by a Subcommittee on Standards for Network Protectors.

COMMITTEE ON SYSTEM ENGINEERING

The technical program of this committee during the past year included sponsorship of one technical session at the Summer General Meeting; two technical sessions, one of which was held jointly with the Committee on Transmission and Distribution, at the Fall General Meeting; and two technical sessions held jointly with the Committee on Power Generation at the Winter General Meeting.

The committee held three meetings during the year, all of which were well attended. These were devoted primarily to the review of progress in the work of each of the five subcommittees and to the formulation of programs for the technical sessions sponsored by the committee at the General meetings. All of the subcommittees met the objectives of their work assignments. One of the committee meetings was a full-day meeting, the afternoon session of which was devoted to a round-table discussion of "Service Security of Lines and Systems."

For the Summer General Meeting of 1953, the System Economics Subcommittee has completed plans to sponsor a technical session on the general subject of "System Economics."

Following are the reports of the various subcommittees:

System Operations Subcommittee is at work on plans for a technical session for the Fall General Meeting, to include papers of particular interest to those concerned with load dispatching and general co-ordination of electric power system operations.

System Controls Subcommittee is continuing study of current developments in the application of improved methods and devices for the control of system frequency and tie-line load control. This is an active subject in which a broad interest is evident. The session devoted to the subject of "System Controls" at the last Winter General Meeting were very well attended. Plans are being made for another technical session on this subject at the Winter General Meeting in 1954.

The study of the economic and operating features of extra-high-voltage transmission systems is under consideration and the possibility of co-ordinated study of related problems in this field by the Committee on System Engineering and the Committee on Transmission and Distribution has been discussed. The System Planning Subcommittee of the Committee on System Engineering will continue studies on this subject.

Administrative Subcommittee held a meeting in March for the purpose of reviewing the membership of the main committee and of the subcommittees, with the objective of determining the organization of the committee for the administrative year 1953–54.

General. The Second Prize Paper Award in the Power Division was presented during the year to Paul H. Jeynes for his paper entitled "Evaluation of Capacity Difference in the Economic Comparison of Alternative Facilities." This paper was solicited and sponsored by the Committee on System Engineering.

COMMITTEE ON TRANSFORMERS

In last year's report, the subdivision of the committee into five standing subcommittees was described. These are: (1) Insulation Tests; (2) Insulation Fluids; (3) Insulation Life; (4) Magnetic Circuit Behavior; and (5) Performance Characteristics. In general, this subdivision has seemed to be quite satisfactory; the following reports the progress in these subcommittees.

Subcommittee on Insulation Tests. Studies on actual service requirements and on insulation properties of materials and designs still are being carried on. The tables specifying test requirements are obsolete, and have been under consideration for the last year. Recently, proposed revisions have been presented, which seem to be quite acceptable, and may be sent to the whole committee for approval shortly.

Insulation power factor tests have been proposed, and are under consideration for factory tests. Difficulties are found in the fact that many are not in favor of specific limits, since they are additional requirements and, in rare cases, are hard to meet, even when the usual dielectric tests are made satisfactorily. The subject is still under consideration, and it is hoped that a solution will be reached. Since various bridges and schemes are used in such measurements, there is some liaison with the Committee on Instruments and Measurements, which is active in the subject of field measurements.

Subcommittee on Insulation Fluids. This subcommittee is undertaking a project on methods and costs of reclaiming insulation oils. To some extent, its interests coincide with activities of the Subcommittee on Insulation Life, since heat and oxidation are factors in the life and properties of oil.

Subcommittee on Insulation Life. Study still is being made of the methods of making heat runs on dry-type transformers.

A change in the measured hot-spot rise of dry-type Class *B* transformers and reactors to 110 degrees centigrade has been approved by the Committee on Transformers, and is to be proposed later to the Standards Committee.

The study on temperature limits for Class *B* and Class *H* materials was begun by pilot tests on Class *B* insulating materials in several laboratories. This method has been called the "component method." In the meantime, the so-called "functional method" has been proposed, which includes tests on model assemblies, and hence tests not only the material but the application. At the present time, the activity on the component method is held up, and investigations of the functional method are in progress.

Revisions of the methods of making temperature tests were published in *Electrical Engineering*, January 1953.

The permissible duration of short circuits and temperature limits are being studied. The maximum mechanical forces due to transient dissymmetry of the short-circuit current are also included. These will result in proposed changes in standards.

Subcommittee on Magnetic Behavior. There is no activity required in such sub-

jects as measurement of exciting currents, losses, and so forth, at the present time. Noise, however, being due largely to the iron circuit, is being actively considered as regards measurement, irritation due to different types of noise, attenuation, methods of reduction, and so forth. It is a difficult subject, and progress is slow. Some liaison with other committees is required in this case.

Subcommittee on Performance Characteristics. The revision of the standards for current-limiting reactors has proved more difficult than previously estimated, but should be completed soon.

There have been no changes proposed for instrument transformers.

The Guides for Operation and Maintenance of Dry-Type Transformers have been published for tentative use.

COMMITTEE ON TRANSMISSION AND DISTRIBUTION

The activities and diversity of subjects considered by the committee continue at a high level. Each of its five subcommittees has sponsored papers and investigations of broad and detailed interest.

Capacitor Subcommittee, composed of 15 engineers representing both utilities and manufacturers, is continuing its interest in AIEE Standard number *18* for capacitors, improved methods of protecting capacitors, and is sponsoring a fundamental investigation of capacitor life expectancy. The 20-page "Bibliography on Power Capacitors" over a 20-year period, published in 1952, and available through the AIEE headquarters, is being brought up to date.

Distribution Subcommittee is continuing its interest in higher distribution voltages, phase unbalance, voltage flicker, and optimum distribution transformer bank loadings.

General Systems Subcommittee published a paper jointly with the Lightning Protective Devices Subcommittee on distribution circuit recovery voltages, which has broad interest. A working group now is being formed to provide a committee report on sleet melting and prevention practices resulting from the interest and information presented in several papers dealing with sleet-melting procedures. The wide scope of subjects sponsored by this subcommittee is indicated by its interest in high-voltage transmission, stability, network analyzers, switching surges, system hunting, and equivalent circuits for unbalanced and untransposed transmission lines.

Lightning and Insulators Subcommittee has sponsored papers and projects involving the characteristics of insulators and wood structures, has published the results of an extensive questionnaire on expulsion tube performance, and is continuing its study of rod gap characteristics, the insulation for transmission lines, lightning phenomena, radio interference, and insulation co-ordination.

Towers, Poles, and Conductors Subcommittee sponsored a most interesting and valuable conference on wood and steel tower construction, including both electrical and mechanical characteristics. This committee is continuing its interest in the detailed design characteristics of towers, including design charts, sag-tension calculations, and characteristics of clamps. This subcommittee has organized a working group to determine the basis for adequate clearances of high-voltage conductors so as to assist the AIEE member of the ASA Standard Committee *C2*, which committee is planning a revision of the National Electric Safety Code.

General. The Committee on Transmission and Distribution has worked cooperatively with the Committee on System Engineering in sponsoring papers on economic loading, and also jointly with the Committee on Substations on papers dealing with conductor joints. One Swedish paper was sponsored by the Capacitor Subcommittee, presenting the performance of series capacitors in Sweden.

The great diversity of subjects and activity is expected to continue in response to the general interest in transmission at all voltage levels and particularly the recent interest in the higher voltage levels.

Science and Electronics Division

COMMITTEE ON BASIC SCIENCES

One of the important functions of this committee is to keep the engineering profession informed about recent developments in the basic fields of physics, chemistry, and mathematics, and to this end a number of conferences were held at the Winter General Meeting. Many of the conference papers were later converted into *Transactions* papers.

The conference sessions were generally sponsored by the subcommittees, as follows:

Subcommittee on Basic Concepts. This new subcommittee held its first symposium at the Winter General Meeting, with papers on logical deductive disciplines and on specific concepts and units. The subcommittee now is preparing a set of recommendations concerning voltage and current notation to be correlated with the ASA project on definitions.

Subcommittee on Dielectrics held three sessions during the year, one on compounds containing fluorine. This subcommittee has formed a working group on the evaluation of the thermal stability of insulating materials to develop basic information for the rational revision of AIEE Standard number *1*.

Subcommittee on Semiconductors and Transistors cosponsored two sessions, including papers on photo-effects, on germanium, and on related subjects in this field.

Two sessions on magnetics described recent work on permanent magnets, ferrites, and silicon-iron alloys, and reviewed recent advances in the theory of magnetic materials.

Subcommittee on Applied Mathematics held one session covering such varied subjects as transients, the theory of queues, and partial differential equations. A session on nuclear detection devices was held by the subcommittee on the electrical properties of gases. Various papers were presented also on electric circuit theory.

Subcommittee on Energy Sources has served its intended purpose of promoting a series of conferences on this subject, and was discontinued after cosponsoring a session on electrets at the Winter General Meeting.

General. Several sessions were devoted to the presentation of *Transactions* papers falling in the general classification of basic sciences.

About 40 papers were reviewed during the year, for *Transactions* and for *Electrical Engineering*, of which about one-half have been recommended for publication.

The membership of the Committee on Basic Sciences has had a turnover of about 25 per cent during the past year, and now has a membership of about 50. Of the almost 100 members of the 7 subcommittees, about 40 per cent are nonmembers of AIEE. This reflects the fact that a substantial portion of the work of the committee is carried on by men who are working in the fields of physics, chemistry, and mathematics, and who bring fresh knowledge from these fields to members of the engineering profession.

COMMITTEE ON COMPUTING DEVICES

The computing devices field is vigorously active, and the workers in the field belong to many technical societies other than the AIEE, including the IRE, Association for Computing Machinery (ACM), and The American Physical Society. As a result, this committee has participated actively in the Joint (AIEE-IRE-ACM) Computer Conference Committee, which consists of members appointed from the AIEE Committee on Computing Devices, the IRE Professional Group on Electronic Computers, and the ACM, which is a special-purpose organization devoted to computing machinery.

This group held a successful 3-day conference in New York, N. Y., on December 10–12, 1952, on components and techniques used in introducing input information into computers and taking out the output results. More than 1,200 engineers attended this meeting, at which 27 technical papers were presented, and 13 manufacturers and scientific organizations displayed and demonstrated input and output equipment used with large high-speed electronic computers. The proceedings of this conference have been published in a 142-page report. The proceedings of the previous conference held by the joint committee in December 1951, which reviewed the postwar progress in large-scale electronic digital computers, has been a major contribution to the computing literature, and over 1,500 copies have been sold at $3.50 each. A great many copies have been used as text material.

Another joint AIEE-IRE-ACM conference was held on the West Coast, February 4–6, 1953. This meeting presented both applications and new developments, instead of being a single-theme meeting.

With three successful conferences held, and both East Coast and West Coast activity to its credit, the joint Computer Conference Committee has become an important undertaking. Following discussion by the three component groups, it has been decided to set up the committee on a semipermanent basis. Each of the three societies will have six members: two ex-officio, and four appointed for 2-year terms, with two membership appointments coming up each calendar year. The proposed scope and operational procedures have been approved by this committee and the Science and Electronics Division Committee. The plan

calls for a national policy-setting group to be called the Joint Computer Committee, and for an ad hoc regional group to be appointed for each conference held.

This committee has supported the joint committee work actively because meetings designed to explore thoroughly a specific topic afford a much-needed opportunity for specialists, and are the most desirable method of working with other societies for advancement of the field. These meetings are a useful and necessary supplement to the AIEE General meeting programs, which more often stress new developments scattered across the field. Since the published proceedings appear as special publications, they can be self-supporting.

Turning to other activities, a Subcommittee on Analogue Digital Converters has been formed, and new subcommittees are planned on Information Storage Devices, Semiconductor Computer Components, Input-Output Devices, and Information Theory.

This committee prepared a paper on computers for the Centennial of Engineering, September 12, 1952. Full committee meetings were held on July 25, 1952, and January 21, 1953; another is planned for June 16 at the Summer General Meeting.

Subcommittee on Analogue-Digital Converters. A session on analogue-digital converters is planned for the Pacific General Meeting, since much of this work is being done on the West Coast.

Subcommittee on Computer Bibliography. The forthcoming bibliography of computing devices literature will be published as a *Transactions* paper.

Subcommittee on Digital Computers. A session on advancements in this area will be held at the Summer General Meeting.

Subcommittee on Digital Computer Comparisons. The principal activity planned for this subcommittee has been the preparation of a survey paper analyzing the requirements of various types of problems presented to computers and the ability of various types of computers to handle problems. This activity has been suspended pending the location of an AIEE member willing to undertake the job.

COMMITTEE ON ELECTRICAL TECHNIQUES IN MEDICINE AND BIOLOGY

The program of the committee for the year 1952–53 was directed toward three objectives: (1) The sponsorship of technical sessions at General meetings, with particular emphasis on the development of a greater proportion of *Transactions* papers and upon joint sessions with other committees; (2) The development and presentation of the program of the Fifth Annual Conference on Electronic Instrumentation and Nucleonics in Medicine; and (3) Successful efforts to organize joint sponsorship of the Sixth Annual Conference on Electronic Instrumentation and Nucleonics in Medicine by AIEE and IRE.

Four conference papers were presented in Minneapolis, Minn., under this committee's auspices on June 26, 1952. Three of these papers were subsequently published in *Electrical Engineering*. A joint session with the Committee on Safety also was conducted in Minneapolis, and two of these papers were published in *Electrical Engineering*.

Through the efforts of Dr. A. M. Zarem, Vice-Chairman of the committee, a session of four papers was presented at the Pacific General Meeting.

The afore-mentioned fifth annual conference was held in New York, November 24 and 25, 1952, at which time 17 papers were presented to more than 200 interested scientists and physicians. The discussions were extensive and stimulating.

At the Winter General Meeting, a joint session with the Committee on Instruments and Measurements included one conference paper and one *Transactions* paper sponsored by this committee. The session sponsored by this committee consisted of three conference papers and two *Transactions* papers.

According to present plans, the committee will sponsor sessions as follows during the coming 6 months: (1) A session in Atlantic City; (2) A program at the Pacific General Meeting; (3) Jointly with IRE, the Sixth Annual Conference on Electronic Instrumentation in Nucleonics and Medicine in the Hotel New Yorker, November 19 and 20, 1953.

It has been particularly gratifying that those who have attended sessions sponsored by this young committee have been enthusiastic in their presentation of papers and discussion of those papers. The sessions held jointly with other committees of the AIEE have been mutually successful to a high degree; therefore continued work along these lines is to be recommended.

It is the opinion of this committee that the AIEE has been most generous and farsighted in sponsoring the work of the committee, which is of interest to members of AIEE and IRE, and also to biologists and physicians.

COMMITTEE ON ELECTRONIC POWER CONVERTERS

In the report of the preceding fiscal year, mention was made of the fact that committee activity was at a low ebb because of the preoccupation of most of the committee members in the expansion of rectifier installations taking place at that time. This condition prevailed during most of 1952, but a marked spurt of activity developed toward the end of the year, culminating in two technical sessions at the Winter General Meeting. The full committee met on January 20, and laid plans for future activities. Various working groups maintained a high level of activity and accomplishment during this time.

Survey of Operation of Mercury-Arc Rectifiers. This survey, started by the Applications Subcommittee, which was dissolved and largely replaced by the Mercury-Arc Rectifier Subcommittee, has been published and distributed.

Conference on Power Tubes and Applications. This conference, sponsored by this committee and the Electron Tubes Subcommittee, was mentioned in the 68th annual report but actually took place in Pittsburgh, Pa., on May 19 and 20, falling within the current fiscal year. The conference was well attended and included presentation of 22 papers which were published in special pamphlet form in July 1952. A special feature of the conference was a panel discussion of rectifier problems for the special benefit of users and students.

Committee Report on "Water Cooling Systems of Mercury-Arc Rectifiers," by the Working Group on Rectifier Cooling and Corrosion Problems. This report has been completed and submitted as a *Transactions* paper for presentation at the Winter General Meeting.

Standards for Hot-Cathode Power Converters. Last year's report was incomplete in that it was not stated that the Subcommittee on Hot-Cathode Power Converters was then working on Section II of the proposed standards. The subcommittee is now proceeding with Section III.

IEC Standards and Revision of C-34 Standards. The Working Group on Revision of *C-34* Standards has delayed activity in its primary task, since it is studying the work of IEC Committee number *22* on the proposed International Standards for Mercury-Arc Rectifiers, and since developments in IEC may influence the contemplated revisions of *C-34*.

A Working Group on IEC Standards worked with the ASA delegates to the IEC 1952 meeting in Holland, and prepared a report on minimum modifications required in the IEC Standards to make them compatible with ours.

A joint working group of *C-34* and the Committee on Electronic Power Converters was appointed to revise the 1953 draft of the IEC International Standards for Mercury-Arc Rectifiers to bring it into conformity with the American draft of April 2, 1952, for submittal at the conference in Yugoslavia in June of this year.

A program is in the preliminary planning stage for presenting our views more effectively to the members of IEC Committee number *22* during its visit in Philadelphia in 1954.

COMMITTEE ON ELECTRONICS

It is with deep regret that the Committee on Electronics must report the loss of its Chairman, J. T. Thwaites, who suffered a heart attack on Thursday, January 15, 1953. Mr. Thwaites' great interest in electronics matters, his wide experience, his extensive knowledge of developments in Europe greatly aided the work of the committee. This, combined with his personality, makes the loss very real, both from a technical and personal standpoint.

Organization. The work of the committee is carried on through 14 subcommittees and five liaison representatives. It is the general policy of the committee to organize new subcommittees when there appears a need for attention to a particular field in electronics. Two new subcommittees, Subcommittee on Electronic Circuit Principles, and Subcommittee on Electronic Systems, were organized during the year to consider the specific fields indicated by their titles. As the work of the subcommittees crystallize and the need becomes definite, committee status is recommended.

In addition to the foregoing, one joint subcommittee, that on Electronic Instruments, has been continued. This committee is sponsored jointly with the Committee on Instruments and Measurements.

Conferences. The committee, either directly or through its subcommittees, has

continued actively to sponsor 2- to 3-day conferences on particular phases of electronics. These conferences provided opportunities for specialists to meet for discussion of technical matters and problems. As an example, the electronic components symposium, which had its second meeting in Washington, D. C., last year, was held again this year on the West Coast, at the Shakespear Club, Pasadena, Calif., April 29–30 and May 1. In general, these conferences are arranged through the co-operative efforts of several of the Institute committees as well as other societies, such as the IRE. These conferences have aroused a great deal of interest, and have played an important part in influencing the very great effort that is being placed on increasing the reliability and performance of electron tubes and electronic circuit components.

Last year, the Subcommittee on Semiconductor Devices co-operated with the corresponding IRE subcommittee to hold a semiconductor symposium at the University of Illinois. This conference, intended primarily for those who work directly in the semiconductor field, is being continued on an annual basis. The conference this year is being held at the Pennsylvania State College.

A meeting of the main committee is held annually at the National Electronics Conference, in Chicago, Ill., and, in addition, this year the Subcommittee on Education is planning a technical session.

A survey is being conducted by the Committee on Electronics to determine the interest of European technical societies in an International Conference on Electron Tubes to be held in the United States in the fall of 1954.

Standards. Very rapid advancement is being made in the semiconductor field, and the Subcommittee on Semiconductor Devices is actively engaged in preparing standards on definitions and test methods. This committee is planning a symposium to be held at the 1953 Summer General Meeting of the Institute to present the work that has been done.

The Joint Subcommittee on Electronic Instruments has prepared proposed standards on: 1. Specifications Outline for Cathode-Ray Instruments; 2. Specifications Outline for Vacuum-Tube Voltmeters; and 3. Specifications Outline for Signal Sources.

The Electron Tube Subcommittee, in co-operating with the corresponding IRE subcommittee, has completed a proposed standard on industrial cathode-ray tubes, and plans to present the matter at a later meeting of the Institute. In addition, surveys are being conducted by working groups on the status and need for standards on other types of industrial tubes, such as high-vacuum control tubes, thyratrons, and ignitrons.

Technical Sessions. The committee, largely through its subcommittees, has been active in arranging and sponsoring technical sessions to keep the Institute membership informed of the technical developments that are taking place in all phases of electronics.

Technical sessions were presented at the 1952 Summer General Meeting on electrostatic precipitation, and additional phases of this subject were discussed further at the Winter General Meeting. This latter session was sponsored jointly with the Committee on Power Generation.

Technical sessions were organized and presented by the Electron Tube Subcommittee on color television tubes, recent developments in electron-tube emitters, and electron tubes for high-frequency generation. Further plans include technical sessions on tubes used in the rapidly expanding ultra-high-frequency field, such as the klystron and traveling-wave tubes; storage tubes for computers; industrial kinescopes; and hydrogen thyratrons for pulse generators.

Technical sessions on electronic circuit principles and electronic systems will be presented at the 1953 Summer General Meeting.

An outstanding session on complexity of electronics systems, arranged by the Subcommittee on Papers and Speakers in co-operation with the Subcommittee on Electronic Systems, was presented at the Winter General Meeting.

COMMITTEE ON INSTRUMENTS AND MEASUREMENTS

To a considerable degree special technical conferences have taken precedence over the General meetings of the Institute as regards the presentation of papers sponsored by the committee.

The 2-day Conference on Recording and Controlling Instruments held in Philadelphia, Pa., November 17–18, 1952, was udged most successful, with 500 registrants. Seventeen original papers were presented, several of which otherwise would have appeared at the Winter General Meeting. Selected papers of this group will be prepared for committee review and possible publication in the *Transactions* for the permanent record.

In similar fashion, at the Conference on High-Frequency Measurements held in Washington, D. C., January 14–16, 1953, numerous papers were presented, some o which were of *Transactions* caliber. And a year ago in Washington, at the Symposium on Quality Components, there were several papers on measurements.

Additionally, a Telemetering Conference was held in Long Beach, Calif., August 26–27, 1952, at which 16 papers on numerous phases of telemetering were presented. In this connection, another Telemetering Conference was held May 20–22, 1953, in Chicago.

The committee thinks these conferences serve those of the membership concerned with measurements, because attendance has been excellent, and the papers have been fresh and of interest to those concerned; the discussions have been in a detail rarely reached at the formal Institute meetings.

It well may be that such conferences partially will replace technical sessions in the formal Institute meetings, and this situation should be generally recognized. It is the belief of this committee that papers at such conference accomplish in an excellent manner the desired result of the dissemination of technical information.

All of these conferences have been sponsored in some degree by the Committee on Instruments and Measurements for the Institute.

Since the last report, the committee held a meeting at the Summer General Meeting in 1952. The first committee meeting of the current business year was held at headquarters, October 21, 1952, and a luncheon meeting was held during the Winter General Meeting. A spring meeting is being planned as well as a luncheon meeting for the committee at the 1953 Summer General Meeting.

Work of the subcommittees is progressing. The new organization is now in hand, and the Subcommittee on Organization will propose a new wording for the scopes of the several subcommittees.

COMMITTEE ON MAGNETIC AMPLIFIERS

The Committee on Magnetic Amplifiers has expanded its main committee membership to a total of 22, and has subcommittees totalling 61 members, with some duplication of membership existing between them and the parent committee. Represented in this over-all membership, are theoretical specialists of laboratories, educational institutions, and industry, designing and manufacturing interests, and users of magnetic amplifiers. An effort is being made now to reach into the aircraft industry and others so far not represented to broaden the coverage of the committee and its subcommittees.

The committee sponsored technical sessions at the Summer and Winter General Meetings, and contributed to other meetings. Two general business meetings of the main committee were held, separate meetings of the subcommittees also having been scheduled throughout the year for transaction of their business. The preparation of papers has been encouraged, and a very satisfactory supply for future meetings has been assured.

Eight subcommittees are included in the operational organization of the Committee on Magnetic Amplifiers, and most activities are handled by them.

Applications Subcommittee has continued its function of encouraging the submission of papers on applications of magnetic amplifiers. This subcommittee is now arranging for presentation of a group of application papers at the 1953 National Electronics Conference. A full-day session was very enthusiastically received at the 1951 conference, and it is expected that the session now under preparation will be equally successful.

Definitions Subcommittee is continuing its work on standardization of definitions and symbols. The progress report of the Magnetic Amplifier Subcommittee (AIEE *Transactions*, volume 70, part I, 1951, pages 445–9) continues to form a basis for their work. Changes and additions to that work are in process to bring it up-to-date, with coverage of the most recent advances in the art. Under consideration at this time is the matter of circuits. Either a separate new subcommittee or a working group under this definitions subcommittee may be set up to compile and classify circuit information.

Dielectric Amplifiers Subcommittee has continued to function under the Committee on Magnetic Amplifiers because of the marked similarity between the theory and application of the two types of devices. This subcommittee, although quite new, is building up a membership of pioneers in the field and already has sponsored several papers on the theory of operation of dielectric amplifiers.

Magnetic Amplifier Theory Subcommittee has greatly expanded its operations. It held business meetings throughout the year, and presented an educational session on magnetic amplifier theory at the Winter

General Meeting. This subcommittee formerly was named the "Nonlinear Circuit Theory Subcommittee," the name having been changed at the last business meeting of the main committee to be more applicable to its scope and functioning.

Principal Groups Subcommittee, which has as its function the compilation of a listing of all persons actively engaged or interested in magnetic amplifier work, has built up a list of more than 200. This list is now being prepared for submission to all committee and subcommittee members for further additions. A questionnaire was originally sent out to assist in the compilation of this information, and the same general procedure is being followed to keep it up-to-date.

Test Codes Subcommittee has continued in its function of setting up test codes both for finished amplifiers and for component parts. Of particular concern have been the magnetic cores. The subcommittee sponsored a group of papers at the Summer General Meeting, which comprised a very successful session. Demonstrations of testing methods were held, and the resulting discussions were very enlightening.

Materials Subcommittee, having made great strides in establishing standardized core dimensions, frequencies, and magnetizing forces for core testing, is now attempting to cover rectifiers as required for magnetic amplifiers. An open meeting of the subcommittee was held at the Winter General Meeting, to which representatives of rectifier interests were invited. During this meeting, the needs of rectifiers for magnetic amplifiers were stressed and methods for testing such rectifiers were discussed.

Standards Subcommittee has completed to a great degree tentative standards for magnetic amplifiers. The work has progressed to a point beyond which it cannot go without more concrete definition of certain terms. The Definitions Subcommittee is co-operating in the solution of these problems, and liaison representation to the AIEE Standards Committee has been arranged to provide proper over-all coordination.

COMMITTEE ON NUCLEONICS

The cloak of secrecy continues to shield most of the new developments in the field of applied nucleonics. Conference papers on those that were not classified have been sought by the Committee on Nucleonics, and many have been or will be presented at Institute sessions. In November 1952, this committee participated jointly with the Committee on Electrical Techniques in Medicine and Biology in a conference on "Electronic Instrumentation and Nucleonics in Medicine," held in New York City. It was well attended by both physicians and engineers specializing in this field. The Committee on Nucleonics gratefully acknowledges the co-operation of other committees in many joint activities. At the Winter General Meeting, the committee sponsored two sessions of conference papers covering unclassified material of wide range.

The committee meeting held at the time of the Winter General Meeting planned programs for the remainder of the year, and endeavored to solve some of the persisting problems of keeping AIEE membership up-to-date on nuclear developments as rapidly as they are removed from classification.

The committee assisted in arranging for talks on progress in the development of atomic power, and on nuclear research in retrospect and prospect, at the general session of the North Eastern District Meeting in Boston.

The Summer General Meeting will include a joint nucleonics and power generation session, at which maintenance problems, precision controls, and other topics relating to reactors will be discussed, with one or more general papers.

Planning is under way with a view to possible participation in the Pacific General Meeting and to participating again in the next joint conference on "Electronic Instrumentation and Nucleonics in Medicine," to be held in New York City, in November 1953.

AWARDS

EDISON MEDAL

The Edison Medal for 1952 was awarded to Doctor V. K. Zworykin, Vice-President, Technical Consultant, and Director of Electronic Research, RCA Laboratories Division, Radio Corporation of America, "for outstanding contributions to the concept and design of electronic components and systems," and was presented to him on January 19, 1953, during the Winter General Meeting.

The medal may be awarded annually for meritorious achievement in electrical science, electrical engineering, or the electrical arts. Awards are made by a committee of 21 members of the Institute.

LAMME MEDAL

The Lamme Medal for 1952 was awarded to I. F. Kinnard, Manager, Engineering Meter and Instrument Department, General Electric Company, West Lynn, Mass., "for his outstanding contributions in design and developments in instrumentation and measurements." The medal will be presented to him on June 15, 1953, during the Summer General Meeting.

The medal may be awarded annually by a committee of nine members to a member of the AIEE for "meritorious achievement in the development of electrical apparatus or machinery."

JOHN FRITZ MEDAL

The John Fritz Medal may be awarded annually for notable scientific or industrial achievements by a board of award composed of representatives of the American Society of Civil Engineers (ASCE), The American Society of Mechanical Engineers (ASME), American Institute of Mining and Metallurgical Engineers (AIME), and AIEE. The 1953 medal was awarded to Benjamin F. Fairless, then president of the United States Steel Corporation, with a citation "as champion of the American free enterprise system, for notable industrial achievement in the production of steel."

The medal was presented to him on September 10, 1952, at the Centennial Day Luncheon, in Chicago, Ill.

HOOVER MEDAL

The Hoover Medal for 1952 was awarded to the Right Honorable Clarence D. Howe, Minister of Trade and Commerce, and Defense Production, Canadian Government, and was presented to him on September 10, 1952, at the Centennial Day Luncheon, in Chicago, Ill.

The Board decided not to make an award in 1953.

The Hoover Medal is awarded by a board representing the ASCE, AIME, ASME, and AIEE "for outstanding civic or humanitarian activities constituting distinguished public service."

MARSTON MEDAL BOARD OF AWARD

This medal is presented annually at the commencement exercises of Iowa State College to a graduate of that institution who has achieved success in his field of engineering.

For the year 1952, the medal was awarded to Fred R. White, Road Engineer, Iowa Highway Commission, for many years.

WASHINGTON AWARD COMMISSION

At a dinner, held at the Furniture Club of America, Chicago, Ill., February 23, 1953, the Washington Award was given to Dr. Gustav Egloff, Director of Research of the Universal Oil Products Company. H. P. Sedwick, President of the Public Service Company of Northern Illinois, presided in the absence of James D. Cunningham, who is chairman of the Commission. Dr. J. T. Rettaliata, President of the Illinois Institute of Technology, represented the ASME; C. Donald Kennedy, Director of Research of the Portland Cement Association, represented the ASCE; Hjalmer W. Johnson, Vice-President of the Inland Steel Company, represented the AIME; and Noah C. Pearcy, Chief Engineer of the Pioneer Service and Engineering Company, represented the AIEE. The attendance was more than 500.

Ovid W. Eshbach, Dean of The Technological Institute, Northwestern University, as this year's president of the Western Society of Engineers (WSE), made the presentation of the award to Dr. Egloff. After the presentation, Dr. Egloff spoke on "The Impact of Petroleum on Our Civilization."

The award is made annually to an outstanding engineer, a citizen or resident of the United States, who ably has served human needs. It is administered by a commission representing the WSE, ASCE, AIME, ASME, and AIEE.

ALESSANDRO VOLTA MEMORIAL FUND

The recipient of the first award of the fund under Institute auspices, Giovanni Malaman, of Milan, Italy, completed last summer his graduate work at Yale University, on the stability of electric power systems and machinery. Mr. Malaman received his masters degree with honors in all subjects. After a tour to visit certain electrical installations in this country, financed by his company, he returned to the Edison Company of Milan, and was immediately promoted.

Dr. H. S. Osborne, Chairman of the Board of Trustees of the Volta Fund, visited Milan in the fall to discuss the administration of grants with the very able committee of

the Italian Electrotechnical Association, which is co-operating with the trustees. He found them well pleased with the results which are being achieved, and the officers of the Edison Company are delighted with the benefits which Mr. Malaman had derived from his year of work in this country.

The award for the academic year 1952–53 was made to Enrico Chiesa, a graduate of the University of Milan, employed by the General Electric Company of Milan. Mr. Chiesa is specializing in industrial servomechanisms at Yale University. A small luncheon in honor of Mr. Chiesa was given during the Winter General Meeting, attended by President Quarles, members of the Board of Trustees of the Volta Fund, and others.

The trustees have offered the award for the year 1953–54 to Maurizio Vallauri, of Turin, for a year of graduate work in ultrahigh frequencies at the Massachusetts Institute of Technology.

CHARLES LeGEYT FORTESCUE FELLOWSHIP COMMITTEE

The availability of this award was announced to department heads of electrical engineering in all colleges in the country that offer accredited programs. After reviewing financial statements, the committee decided to award two fellowships for the academic year 1953–54, each to carry a stipend of $2,000. Twenty-three applications were received. Most applicants appeared to be well-qualified for graduate level work.

The recipients of the award for the coming year are: Richard C. Heyser and John M. Tomlinson. Mr. Heyser is completing his bachelor of science degree at the University of Arizona and will do his graduate work at the California Institute of Technology. Mr. Tomlinson is completing his master of science degree requirements at the Pennsylvania State College and will start the first year of his doctorate at the same institution this fall.

ALFRED NOBLE PRIZE

The Alfred Noble Prize for the year ending June 1, 1952, was awarded to Professor Myron Tribus, a member of ASME, for his paper "Intermittent Heating for Aircraft Ice Protection With Application to Propellers and Jet Engines." The prize is a cash award of $350, accompanied by a certificate signed by the president and secretary of ASCE (which society has been designated as trustee of the fund) and bears the names of the societies participating in the award.

The best of 25 AIEE papers were considered along with entries from AIME, ASME, and ASCE. No entry was received from WSE, the fifth society participating in the award.

The prize was established in 1929 and is awarded to a member in any grade of one of the five participating societies for a technical paper of exceptional merit presented before one of the societies and included in its technical publications, provided the author has not passed his 31st birthday at the time the paper is submitted.

The purpose of the prize is to perpetuate the name and achievements of Alfred Noble, past president of ASCE and WSE. It provides a means for recognizing and encouraging the work of young engineers.

The recipient of the prize is selected by a committee of five, consisting of one representative of each society, and is presented at a general meeting of the society of which the recipient is a member, by a representative of the ASCE.

JOINT ACTIVITIES

UNITED ENGINEERING TRUSTEES, INC.

For the four Founder Societies, the United Engineering Trustees, Inc., (UET) administers the funds and property in the Engineering Societies Building, the Engineering Societies Library, and the Engineering Foundation. It also serves as treasurer of ECPD.

A comprehensive report on possibilities of procuring an adequate building as a home for engineering societies has been submitted by the UET to the Founder Societies, with certain questions, the answers to which will aid in proceeding with plans if there is agreement on the major aspects.

While these studies are continuing, the cost of repairs in the present building is kept to a minimum. Replacement of the elevator cars and related repairs required by the city have been completed.

ENGINEERING FOUNDATION

The Engineering Foundation is a department of UET, organized for "furtherance of research in science and engineering," and administering funds set aside to carry out its objectives.

The Foundation has been supporting 16 research projects, sponsored by the Founder Societies, at an annual cost of approximately $36,000 per year. Substantial progress in all projects has been reported.

ENGINEERING SOCIETIES LIBRARY

The Engineering Societies Library is owned and operated by the Founder Societies through the UET for the engineering profession. Its shelves contain about 170,000 volumes. It receives 1,400 periodicals each year. During the year ending September 1952 it served 39,000 individuals in person or by mail. About 4,400 orders for photostatic copies of documents were filled; microfilm copies were provided for 176 clients, 2,800 books were lent, and over 14,000 mail and telephone inquiries were answered. Hundreds of searches, translations, and bibliographies are prepared annually. AIEE members, by virtue of their organized support of the library, enjoy special privileges and discounts in library services. The annual contribution of the Institute to the support of the library is about $20,000.00. Two members of the AIEE serve on the Engineering Societies Library Board.

The Library Board has decided to engage in more active efforts to publicize the regular and special services of the library. In this connection, a display board with illuminated transparencies, sequentially lighted, was developed. The display has been and will be shipped to various national and Section meetings of the Founder Societies and included the AIEE Winter General Meeting, 1953. Favorable comment has been received.

Other means of increasing the income of the library are being considered in order to combat the present upward trend of operating costs. These measures are becoming urgently necessary since the library is experiencing difficulty in engaging competent personnel, when necessary, since the salaries are not comparable with other libraries, and, also for the same reason, the older employees of the library are not as well off as in years gone by.

Excellent co-operation of the Founder Societies representatives on the Board can be reported. This should result in the library continuing as a valuable service to the profession.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

ECPD has actively pursued its over-all program, making full use of its strong AIEE support. A new booklet designed to interest the high school student in engineering has been produced, "Engineering—A Creative Profession." The hoped-for increase in freshman enrollment in engineering colleges as experienced last fall will be repeated this year if ECPD's efforts have the expected effect. Accreditation procedures have been carried out with increased effectiveness. An experiment with joint inspection of engineering colleges and curricula is under way with the Middle States Association of Colleges and Secondary Schools. An experimental program of postcollege training is being tried out in Cincinnati, Ohio; if successful as expected, this work will be expanded. As a result of the Conference of the Engineering Societies of Western Europe and the United States in 1951, and the 1953 London Conference on Engineering Education, co-operative international efforts have been increased. The "Model Law" for licensing of engineers in the various United States is judged to need no revision. An ECPD grant to the American Society for Engineering Education will help initiate a study on evaluation of engineering education.

ENGINEERS JOINT COUNCIL

The major activity of EJC during the year 1952–53 was the change in its constitution to permit proportional voting of member organizations in accordance with the number of individual members. In addition, the Council agreed to expand its membership and eight societies were invited to join. Three of the eight had accepted membership up to the first of April, and some others were expected to take action shortly.

The Council is continuing the good work of the Engineering Manpower Commission in increasing the number of students in engineering colleges and obtaining better co-operation between military agencies and industry.

The Council has changed its pattern of operation in connection with the new constitution and selected T. A. Marshall, Jr., as the permanent secretary in place of having the secretaryship rotate with the presidency. The permanent office and staff will lend considerable stability to the organization.

JOINT AIEE-IRE CO-ORDINATION COMMITTEE

During this, the third year of its existence, the joint committee held two meetings. The secretaries of the two societies have been made regular members of the committee in addition to the two representatives of each Board of Directors, thus providing

for continuity as well as for close co-ordination with the headquarters' functions.

There has been considerable discussion of the problems relating to the operation of Joint Student Branches, and the authority and responsibilities of the Joint Student Branch Subcommittee have been broadened as a result.

AIEE technical committees as well as the Sections have been advised of the policy of co-operation with IRE in serving engineers active in the fields covered by both societies, so that they may be alert to opportunities for such constructive action.

REPRESENTATIVES

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The American Association for the Advancement of Science has been in the course of examining its own structure and procedures and has made some changes in headquarters administration, all in the interest of enabling the Association to measure up to its opportunities and responsibilities in the light of present and future conditions. This would seem to be a healthy state of affairs.

ADVISORY COMMITTEE ON INFORMATION FOR INDUSTRY OF THE ATOMIC ENERGY COMMISSION

Two meetings of this committee were held, and visits were made to the Argonne and the Brookhaven Laboratories.

The work of the committee is new. It is advisory to the newly established Industrial Information Committee, which assists the Atomic Energy Commission (AEC) staff in guiding the information-for-industry activities throughout the atomic energy program. There is a Liaison Subcommittee of the Industrial Information Committee for co-ordinating the work of the Industrial Information Committee and the Advisory Committee on Information for Industry.

The main function of the Advisory Committee is to become acquainted with the AEC activities and advise on information that would be of interest to industry if and when cleared.

UNITED STATES NATIONAL COMMITTEE OF THE COMMISSION INTERNATIONALE DE L'ECLAIRAGE (CIE)

The outstanding event of the year 1950–51 for the United States National Committee (USNC) of the CIE was the international meeting held in Stockholm, Sweden, June 26–July 5, 1951. The 18 official delegates to these sessions formed what probably was the largest delegation from the United States ever to attend one of these meetings. Twenty countries were represented by official delegations.

The proposal originating in the USNC, that papers of general interest be presented at these sessions, met with general acceptance. At Stockholm, 30 papers were presented, six written by United States authors. In addition, a paper on "Seeing, Light, and Color" by Dr. R. M. Evans of Eastman Kodak Company, was presented at a special meeting attended by King Gustaf VI Adolph of Sweden.

Acting upon the request of an established English manufacturing company having the registered trademark ICI, it was recommended that the French version of the name of the Commission be adopted as the only official name (Commission Internationale De L'Eclairage—CIE) and that all national committees use this name rather than the former English version (International Commission on Illumination—ICI).

Numerous recommendations came out of the technical sessions of these meetings. These involve recommendations affecting the definitions of units and terms used in illuminating engineering, colorimetry and photometry, the specification of color for light signals, and many recommendations to technical committees relative to the work carried out through these committees. The USNC took prompt action on certain of these recommendations opposed by this country, and filed objections with Central Bureau.

Because of the deficit at the time the Central Bureau was transferred to the United States, the USNC secured sustaining contributions from United States industry, amounting to about $25,000, to wipe out the deficit and provide operating funds for the period to June 1952. While the budget adopted in Stockholm for the interim to June 1955 indicates another deficit of about $3,000, it is understood that this deficit will be covered by sustaining contributions in the form of money, materials, or other assistance to be obtained from non-American countries.

The United States delegation to these meetings was most gratified that Dr. Ward Harrison was elected President of CIE.

The next international sessions now are scheduled for 1955, in Switzerland.

The 1952 meeting of the USNC held in Swarthmore, Pa., November 18 and 19, was attended by 27 representatives, including all three AIEE representatives, and was given principally to the organization of the USNC and the Secretariats assigned to it.

As a result of a new scheme of subdivision and allocation of Secretariats, adopted in Stockholm, the USNC has been assigned seven Secretariats, as follows: colorimetry, 1.3.1; colors of signal lights, 1.3.3; operating accessories, 2.1.3; predetermination of illumination and luminance, 3.1.1.1; lighting for photography, television, and cinema production, 3.1.9.2; air-borne lighting and signal, 3.3.3; and popular education, 4.1.2.

For each of these, the USNC appointed a Secretariat Director and an advisory committee. For all other CIE technical committees, a United States representative and an advisory committee were appointed. It is the work of these technical committees that will form the basis for the technical sessions of the 1955 meeting in Switzerland.

INTER-SOCIETY CORROSION COMMITTEE, NATIONAL ASSOCIATION OF CORROSION ENGINEERS

The Inter-Society Corrosion Committee held its fifth annual meeting during the annual conference in Chicago, Ill., March 16–20, 1953, of its sponsor organization, the National Association of Corrosion Engineers. In addition to the acceptance and discussion of reports on 1952 activity from the national organizations whose delegates constitute the membership of the committee, progress was reported with respect to several items included in the statement of objectives and scope in the bylaws of the committee. Of most interest to the AIEE, are a revision and extension of the glossary of terms used in corrosion, and the institution of improved arrangements for acquainting delegates and others interested with the scheduled dates of meetings, concerned with corrosion, of societies represented on the committee. Further steps also have been taken toward arranging for correspondence with workers in corrosion in foreign countries.

NATIONAL ELECTRONICS CONFERENCE

The eighth annual National Electronics Conference was held September 29, 30, and October 1, in the Hotel Sherman in Chicago, Ill., with the AIEE as one of five sponsors. Attendance exceeded 6,000 people, and it was felt that the new location in the Hotel Sherman contributed both to the attendance and to the excellence of the exhibits.

There were 117 exhibit booths occupied by manufacturers of electronic equipment, which assured the financial success of the conference. The technical program consisted of 97 papers presented in 21 sessions. Overflow crowds prevailed at a few sessions, but it is hoped that additional hotel facilities will relieve this situation at the 1953 conference.

All 97 papers are available in the proceedings of the conference published in February 1953. The AIEE representative is currently serving as president of the conference.

NATIONAL FIRE WASTE COUNCIL

The National Fire Waste Council held its annual meeting in Washington, D. C., on April 3, 1953. Three excellent papers, dealing with "Better Community Fire Protection" were presented. The movies showing what should be done "Until the Fire Department Arrives" and "How to Fight a Fire in the Kitchen" were interesting and instructive. Branches and Sections of the Institute undoubtedly could make good use of such movies. For further information, write to the National Fire Waste Council, 1615 H Street, N. W., Washington 6, D. C.

NATIONAL RESEARCH COUNCIL

The National Research Council of the National Academy of Sciences has been very active during the year. It has enlarged the publication policy and is issuing a bimonthly *News Report*. Copies of these reports are available in the Engineering Societies Library. Of particular interest to engineers, are its investigations and conferences dealing with marine cargo handling and transport, housing and building in hot humid and hot dry climates, electrical insulation, and highway construction. Among its new publications are: "A Digest of Literature on Dielectrics," "Highway Relationship and the Performance of Concrete Pavements," and "A Study of Conservation in Building Construction." The Council has organized a Building Research Advisory Board and a Minerals and Metals Advisory Board. These two Boards have wide fields to study and correlate. The Metals Board has undertaken as one of its problems new assignments for metals.

UNITED STATES NATIONAL COMMITTEE OF THE WORLD POWER CONFERENCE

During the past fiscal year, the tie between the World Power Conference and the engineering societies was considerably strengthened. The EJC has become the Secretary of the United States National

Committee, and the custodian of the funds which are used to support the United States National Committee and the United States share of the World Power Conference. It has been agreed to hold the next meeting of the International Executive Committee in Western Germany in September 1953. The Western Hemisphere is also to be host to the next meeting of the World Power Conference in Sao Paulo, Brazil, in 1954, and the United States representatives are being requested to prepare their allotted proportion of the papers for the conference.

APPRECIATION

The Board of Directors wishes to record its appreciation of the continuing excellent work of the general committees, the technical divisions and committees, and the District, Section, and Branch officers and committees. It also expresses its thanks to the membership for the widespread interest and participation in the activities.

Respectfully submitted for the Board of Directors.

H. H. HENLINE
Secretary

HASKIN & SELLS
CERTIFIED PUBLIC ACCOUNTANTS

250 PARK AVENUE
NEW YORK 17

ACCOUNTANTS' CERTIFICATE

American Institute of Electrical Engineers:

We have examined the balance sheet of American Institute of Electrical Engineers, and schedule of securities owned, as of April 30, 1953, and the related statements of income and operating fund reserve and of restricted fund reserves for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet, schedule of securities owned, and statements of income and operating fund reserve and of restricted fund reserves present fairly the financial position of, and securities owned by, the Institute at April 30, 1953 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(*Signed*) HASKINS & SELLS

New York,
May 21, 1953

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit A — **Balance Sheet, April 30, 1953**

ASSETS			LIABILITIES		
Property Fund Assets:			**Property Reserve Fund:**		
Founder's interest (one-fourth) in capital assets of United Engineering Trustees, Inc.:			Founder's interest (one-fourth) in capital assets of United Engineering Trustees, Inc.:		
Land, buildings, and equipment (less funded depreciation and renewal reserve)	$284,856.57		Land, buildings, and equipment (less funded depreciation and renewal reserve)	$284,856.57	
Funded depreciation and renewal reserve	213,591.91		Funded depreciation and renewal reserve (invested in marketable securities by United Engineering Trustees, Inc.)	213,591.91	
Total	$498,448.48		Total	$498,448.48	
Equipment:			Other property	29,015.42	
Library (nominal value)	1.00				
Office furniture and fixtures (less reserve for depreciation, $42,217.05)	26,013.07				
Works of art, etc.	3,001.35				
Total property fund assets		$ 527,463.90	Total property fund reserve		$ 527,463.90
Restricted Fund Assets:			**Restricted Fund Reserves (Exhibit C):**		
Securities—at cost (quoted market value, $761,516.26)—Schedule 1	$669,952.98		Reserve capital fund	$617,155.37	
Cash:			Life membership fund	6,528.14	
Reserve capital fund	2,587.33		Member-for-Life fund	16,309.80	
Life membership fund	1,485.44		International Electrical Congress of St. Louis Library fund	6,618.74	
Member-for-Life fund	6,448.35		Edison Medal fund	9,207.16	
International Electrical Congress of St. Louis Library fund	1,576.04		Lamme Medal fund	9,258.22	
Edison Medal fund	75.91		Mailloux fund	1,024.97	
Lamme Medal fund	325.78		Volta Memorial fund	17,905.90	
Mailloux fund	1,024.97		Retired employees' insurance fund	4,000.00	
Volta Memorial fund	279.65				
Retired employees' insurance fund	4,000.00				
Accrued interest—other than reserve capital fund	251.85				
Total restricted fund assets		688,008.30	Total restricted fund reserves		688,008.30
Operating Fund Assets:			**Operating Fund Reserve, Liabilities, Etc.:**		
Cash (not including $3,267.54 Federal taxes withheld)	$ 99,979.00		Accounts payable	$ 44,718.97	
Accounts receivable:			Deferred income:		
Members—for dues (less reserve, $10,000.00)	13,369.77		Dues received in advance	4,530.65	
Advertisers	2,975.33		Entrance fees and dues advanced by applicants for membership	1,270.60	
Technical Conference loans	1,600.00		Subscriptions to publications received in advance	28,137.10	
Miscellaneous	16,447.25		Miscellaneous (including unallocated receipts)	1,655.23	
Accrued interest—reserve capital fund	2,269.27		Operating fund reserve (Exhibit B)	98,622.32	
Inventories:					
Transactions	1,665.00				
Text and cover paper	11,151.19				
Badges	6,167.19				
Production charges for May issue of *Electrical Engineering*	22,905.87				
Travel advances	405.00				
Total operating fund assets		178,934.87	Total operating fund reserve, liabilities, etc.		178,934.87
Total		$1,394,407.07	**Total**		$1,394,407.07

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit B — **Statement of Income and Operating Fund Reserve for the Year Ended April 30, 1953**

Income:		
Dues (including $296,375.50 allocated to *Electrical Engineering* and bimonthlies subscriptions)	$527,550.88	
Advertising in *Electrical Engineering*	334,355.72	
Transactions subscriptions	19,552.07	
Electrical Engineering subscriptions	36,972.95	
Miscellaneous publications (preprints, Standards, bimonthlies, and other publications)	74,010.75	
Students' fees	26,033.70	
Entrance fees	21,893.50	
Registration fees—Institute meetings and technical conferences	26,304.59	
Membership badges	4,323.10	
Transfer fees	2,505.00	
Interest and dividends on investments of Reserve Capital Fund	29,412.45	
Refund of prior year contribution to Centennial of Engineering	700.76	
Total income		$1,103,615.47
Expenses:		
Publications expense:		
Electrical Engineering		
Text	$217,629.08	
Advertising	153,273.61	$370,902.69
Transactions		24,714.11
Proceedings		17,074.52
"Year Book"		18,939.13
Bimonthly publications		63,101.99
Special and technical conference publications		48,411.19
Institute meetings		40,807.17
Institute Sections		97,285.80
Institute Branches, including paper prizes, etc.		13,939.05
Finance Committee		1,100.00
Headquarters Committee		165.96
Membership Committee		22,219.38
Forward	$718,660.99	$1,103,615.47
Total Income (forward)		$1,103,615.47
Expenses (forward)	$718,660.99	
Standards Committee	16,212.66	
Technical committees	19,243.17	
Committee on Public Relations	13,981.46	
Constitution and Bylaws Committee	1,487.81	
Lamme Medal Committee	33.53	
Traveling expenses:		
Geographical Districts:		
Executive Committees	9,098.73	
Vice-Presidents	1,895.76	
Conferences on Student Activities	13,724.31	
Board of Directors	15,359.63	
Nominating Committee	1,481.99	
President's appropriation	733.79	
Administrative expenses	129,338.32	
Geographical Districts—Branch paper prizes	795.96	
Institute prizes	525.92	
Retirement system—AIEE—normal contribution	10,515.64	
American Standards Association	2,000.00	
Canadian Radio Technical Planning Board	20.00	
Engineers' Council for Professional Development	2,807.50	
Engineering Foundation Project—Welding Research	250.00	
Engineers Joint Council	987.00	
National Council of State Boards of Engineering Examiners	500.00	
United States National Committee—International Commission on Illumination	300.00	
National Fire Protection Association	100.00	
United Engineering Trustees, Inc.:		
Building assessments	23,379.68	
Library assessments	17,774.50	
Library retirement plan	4,258.15	
Membership badges	4,810.91	
Legal services	649.50	
Rent, etc.—Editorial office, 500 Fifth Avenue	6,905.65	
Exchange allowances	8,412.47	
Reversal of excess provision for doubtful accounts	(5,000.00)	
Total expenses		1,021,245.05
Excess of Income Over Expenses for the Year		$ 82,370.42
Operating Fund Reserve, May 1, 1952		53,654.40
Total		$ 136,024.82
Less Transfers to:		
Reserve Capital Fund	$ 33,000.00	
Retired Employees' Insurance Fund	2,000.00	
Property Fund Reserve for expenditures (net) for furniture and fixtures	2,402.50	
Total transfers		37,402.50
Operating Fund Reserve, April 30, 1953		$ 98,622.32

( ) Denotes red figure.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit C — **Statement of Restricted Fund Reserves for the Year Ended April 30, 1953**

	Total	Reserve Capital Fund	Life Membership Fund	Member-for-Life Fund	International Electrical Congress of St. Louis Library Fund	Edison Medal Fund	Lamme Medal Fund	Mailloux Fund	Volta Memorial Fund	Retired Employees' Insurance Fund
Balance, May 1, 1952	$637,923.90	$584,167.97	$6,711.07	$14,685.66	$6,618.24	$4,167.91	$1,024.50	$18,548.55	$2,000.00	
Additions:										
Contributions	$ 14,247.70					$9,131.25	$5,116.45			
Transfers from operating fund	35,000.00	$ 33,000.00								$2,000.00
Income from investments	1,594.26	*	$ 137.50	$ 262.50	$ 137.50	450.00	216.76		$ 390.00	
Interest on bank balances	59.73		35.26					$ 24.47		
Dues paid by Members for Life	2,875.00			2,875.00						
Profit (loss) on sale of securities, etc.	(12.60)	(12.60)								
Total additions	$ 53,764.09	$ 32,987.40	$ 172.76	$ 3,137.50	$ 137.50	$9,581.25	$5,333.21	$ 24.47	$ 390.00	$2,000.00
Total	$691,687.99	$617,155.37	$6,883.83	$17,823.16	$6,755.74	$9,581.25	$9,501.12	$1,048.97	$18,938.55	$4,000.00
Deductions:										
Authorized withdrawal from life membership fund	$ 355.69		$ 355.69							
Purchase of medals, cost of engraving, etc. (exclusive of $33.55 paid from operating fund for Lamme Medal)	478.97					$ 236.07	$ 242.90			
Library purchases	161.00				$ 137.00			$ 24.00		
Traveling expenses—District Branch prize winners	1,513.36			$ 1,513.36						
Scholarship award	1,032.65								1,032.65	
Cost of printing bylaws	138.02					138.02				
Total deductions	$ 3,679.69		$ 355.69	$ 1,513.36	$ 137.00	$ 374.09	$ 242.90	$ 24.00	$ 1,032.65	
Balance, April 30, 1953 (Exhibit A)	$688,008.30	$617,155.37	$6,528.14	$16,309.80	$6,618.74	$9,207.16	$9,258.22	$1,024.97	$17,905.90	$4,000.00

* Income on Reserve Capital Fund credited to Operating Fund.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Schedule 1 — **Securities Owned, April 30, 1953**

Name of Issuer and Title of Issue	Principal Amount	Restricted Funds: Reserve Capital Fund	Life Membership Fund	Member-for-Life Fund	International Electrical Congress of St. Louis Library Fund	Edison Medal Fund	Lamme Medal Fund	Volta Memorial Fund	Total
Railroad Bonds:									
Baltimore & Ohio, Pittsburgh, Lake Erie & West Virginia System refunding 4%, due 1980	$10,000.00	$ 6,450.00							$ 6,450.00
New York Central Railroad Company 4% series A consolidated mortgage, due 1998	15,000.00	9,812.50							9,812.50
Northern Pacific Ry. Co. 4½% collateral trust, due 1975	13,000.00	13,266.50							13,266.50
Total railroad bonds		$ 29,529.00							$ 29,529.00
Public Utility Bonds:									
Amer. Tel. & Tel. Co. 2¾% debentures, due 1971	$ 5,000.00			$4,775.00					$ 4,775.00
Amer. Tel. & Tel. Co. 2¾% debentures, due 1975	20,000.00	$ 10,062.50	$5,031.25		$5,031.25				20,125.00
Phila. Electric Co. first refunding 2⅝%, due 1967	10,000.00	10,325.00							10,325.00
Total public utility bonds		$ 20,387.50	$5,031.25	$4,775.00	$5,031.25				$ 35,225.00
Industrial Bonds:									
Shell Union Oil Co. 2½% debentures, due 1971	$20,000.00	$ 19,800.00							$ 19,800.00
Standard Oil Co. of N. J. 2¾% debentures, due 1971	20,000.00	19,675.00							19,675.00
Total industrial bonds		$ 39,475.00							$ 39,475.00
Dominion of Canada, Externals 3%, Due 1963	$11,000.00	$ 10,050.00						$ 1,003.75	$ 11,053.75
United States Government Bonds:									
Defense bonds series G 2½%, due December 1, 1954	$18,000.00	$ 13,000.00		$5,000.00					$ 18,000.00
Treasury savings bonds:									
Series G 2½%, due Sept. 1, 1955	40,000.00	40,000.00							40,000.00
Series G 2½%, due Nov. 1, 1956	17,000.00	17,000.00							17,000.00
Series G 2½%, due May 1, 1957	20,000.00	20,000.00							20,000.00
Series G 2½%, due Oct. 1, 1957	30,000.00	30,000.00							30,000.00
Series G 2½%, due May 1, 1961	30,000.00	30,000.00							30,000.00
Series G 2½%, due July 1, 1961	15,000.00	15,000.00							15,000.00
Treasury bonds 2½%, due Dec. 15, 1962/59	16,000.00							$16,480.00	16,480.00
Total United States Government bonds		$165,000.00		$5,000.00				$16,480.00	$186,480.00
Total Bonds		$264,441.50	$5,031.25	$9,775.00	$5,031.25			$17,483.75	$301,762.75
Capital Stocks:	Number of Shares								
Preferred Stocks:									
Atchison, Topeka & Santa Fe Railway Company	400	$ 19,174.71							$ 19,174.71
Dow Chemical $4 cumulative, series A	100	11,547.50							11,547.50
E. I. du Pont de Nemours & Co. $4.50 cumulative	50						$5,952.00		5,952.00
General Motors Corporation $5	224	25,820.00					2,980.44		28,800.44
Ohio Edison Company 4.40%	200	21,279.25							21,279.25
Scovill Manufacturing Co. 3.65% cumulative	100	10,111.25							10,111.25
United States Steel Corporation 7% cumulative	100	14,885.00							14,885.00
Total preferred stocks		$102,817.71					$8,932.44		$111,750.15
Common Stocks:									
American Gas & Electric Company	861	$ 15,069.04							$ 15,069.04
Caterpillar Tractor Company	300	14,367.28							14,367.28
Consolidated Natural Gas Company	100	4,355.47							4,355.47
Eastman Kodak Company	363	9,699.90							9,699.90
E. I. du Pont de Nemours & Company	300	12,278.14							12,278.14
General Electric Company	350	7,748.66				$9,131.25			16,879.91
General Motors Corporation	200	4,235.53							4,235.53
Gulf Oil Corporation	312	9,198.20							9,198.20
Halliburton Oil Well Cementing Company	300	14,930.35							14,930.35
International Paper Company	300	14,479.88							14,479.88
Louisville & Nashville Railroad Company	100	6,278.13							6,278.13
Monsanto Chemical Company	100	9,635.60							9,635.60
Montgomery Ward Company	300	22,237.65							22,237.65
Owens-Illinois Glass Company	200	15,167.11							15,167.11
Pacific Gas and Electric Company	200	8,216.82							8,216.82
Public Service Company of Indiana	300	8,547.39							8,547.39
Public Service Electric and Gas Company $1.40 dividend preference common stock	500	14,462.43							14,462.43
Sears, Roebuck and Company	400	6,014.97							6,014.97
Socony-Vacuum Oil Company	400	8,146.18							8,146.18
Standard Oil Company of New Jersey	400	9,910.35							9,910.35
Standard Oil Company of Ohio	330	15,272.04							15,272.04
Texas Utilities Corporation	300	9,780.29							9,780.29
Union Carbide & Carbon Corporation	300	7,277.42							7,277.42
Total common stocks		$247,308.83				$9,131.25			$256,440.08
Total capital stocks		$350,126.54				$9,131.25	$8,932.44		$368,190.23
Total		$614,568.04	$5,031.25	$9,775.00	$5,031.25	$9,131.25	$8,932.44	$17,483.75	$669,952.98

OF CURRENT INTEREST

Storm Detector Radar Tracked Recent Worcester, Mass., Tornado

The tornado that roared through Worcester, Mass., and vicinity recently, leaving a path of death and destruction behind, was detected in its formative stages approximately 45 miles outside of Worcester, and the storm was tracked on its devastating course by a radar device built by Raytheon Manufacturing Company of Waltham, Mass.

This experimental storm detection device was developed by Raytheon under direction of the United States Army Signal Corps. It is capable of giving valuable data on the whereabouts of storm precipitation, and on the distance, height, course, and speed of storms. Equipped with automatic cameras, it keeps a photographic record of the data it collects.

The equipment which made the observations was installed at the Massachusetts Institute of Technology and was being used in connection with meteorological research conducted under the sponsorship of the Signal Corps.

Although the radar operators had no way of knowing that they were looking at the birth of a tornado, they were convinced that the storm was apparently one of extraordinary size and fury. However, the fact that it was a tornado was not suspected until it actually struck. The maximum altitude to which the height scope on the device was calibrated was 50,000 feet, yet the approaching storm gave a strong "radar return" to this maximum altitude without a sign of diminishing intensity.

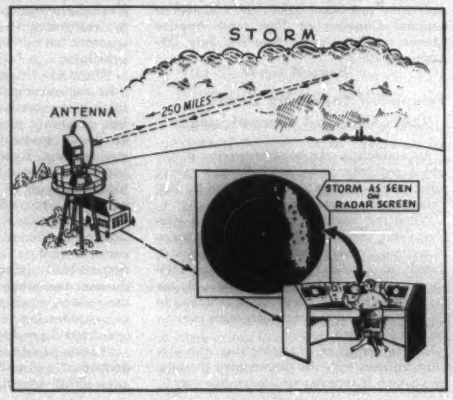
Ordinarily a thundercloud, known technically as "cumulo-nimbus," builds up vertically and may reach 5 miles into the air. On occasion, mighty thunderheads have been reported reaching even higher, to 45,000 feet. The Worcester storm, on the other hand, was showing precipitation at that height, which suggested an over-all altitude far greater. The height of a storm cloud is a strong indication of its power and fury.

Later, the reports of several aircraft pilots were correlated with information from ground observers, the radar photographs, and Weather Bureau instrument readings. This correlation fixed the height of the storm at approximately 75,000 feet, or over 14 miles. Strangely enough, this cloud was not the cumulo-nimbus or thunderhead type, with its characteristic, anvil-shaped top, but was an ordinary cumulus cloud, usually associated with fair weather.

Raytheon scientists stated that several types of search radar, both air-borne and and land based, have the inherent ability to pick up a "return" from rain, snow, or ice crystals in the sky. It was this knowledge that prompted the construction of a radar device designed specifically to find storms, spot their course, and give additional information about them. So far, the storm detector radar has demonstrated its ability to find storms within line-of-sight distances of 200 miles with consistent success—and under favorable conditions, to give results over distances of 300 miles or more.

The radar will not detect cloud formations as such, but will show the presence of rain, snow, hail, or ice crystals. It is usually possible to distinguish between rain and the frozen forms of precipitation, because of the differences in their reaction to radar waves. The radar images are recorded on a "plan position indicator," or PPI scope, and a "range height indicator," or RHI scope. The first of these scopes shows the direction in which the storm lies, and also its distance. The second scope indicates the altitude of that part of the storm where precipitation is taking place. These images are periodically photographed for later study.

Currently, an experienced observer can obtain the following information from the radar: detect the presence of a storm within the range of the device; determine the direction, distance, and height of the precipitation; follow the storm over a period of time and thereby learn the course and the speed with which it is traveling; and observe the falling rain or snow. Additional information appears to be deducible with present equipment. Further developments in both apparatus and techniques already visualized promise even greater potentialities in this form of attack on the weather problem.



Storm detector radar works by sending out a radar beam which bounces off storm precipitation and returns to the antenna. The reading thus obtained is shown on the scope (inset), which is one of the indicators on the panel of the console (lower right). The example illustrated is of a stratus-cloud rainstorm at a distance of 250 miles

Future Meetings of Other Societies

American Transit Association. Annual Meeting. August 10–12, 1953, Hotel Biltmore, Los Angeles, Calif.

Canadian Electrical Manufacturers Association. 9th Annual Meeting. September 23–25, 1953, General Brock Hotel, Niagara Falls, Ontario, Canada

Eastern Electrical Wholesalers Association. 2d National Electrical Industries Show. September 29–October 1, 1953, 69th Regiment Armory, New York, N. Y.

Electrochemical Society. September 13–16, 1953, Ocean Terrace Hotel, Wrightsville, N. C.

Engineers' Council for Professional Development. Annual Meeting. October 15–17, 1953, Hotel Statler, New York, N. Y.

Illuminating Engineering Society. National Technical Conference. September 14–18, 1953, Hotel Commodore, New York, N. Y.

Institute of the Aeronautical Sciences and Royal Aeronautical Society. 4th International Aeronautical Conference. September 7–17, 1953, London, England

Instrument Society of America. 8th National Instrument Conference. September 21–25, 1953, Hotel Sherman, Chicago, Ill.

International Association of Electrical Inspectors. 25th Jubilee Meeting. September 21–26, 1953, Edgewater Beach Hotel, Chicago, Ill.

National Electronics Conference. 9th Annual Conference. September 29–30, 1953, Hotel Sherman, Chicago, Ill.

Pennsylvania Electric Association. Annual Meeting. September 22–23, 1953, Benjamin Franklin Hotel, Philadelphia, Pa.

Society of Automotive Engineers. International West Coast Meeting. August 17–19, 1953, Georgia Hotel, Vancouver, British Columbia, Canada

Society of Automotive Engineers. National Tractor Meeting and Production Forum. September 14–17, 1953, Hotel Schroeder, Milwaukee, Wis.

West Coast Electronic Manufacturers' Association and 7th Region of the Institute of Radio Engineers. Western Electronic Show and Convention. August 19–21, 1953, San Francisco Civic Auditorium, San Francisco, Calif.

ECPD Annual Meeting to Be Held in New York

The annual meeting of Engineers' Council for Professional Development (ECPD) will be held in New York, N. Y., October 15–17, 1953. The Engineering College Research Council (ECRC) and the Engineering College Administrative Council (ECAC) of the American Society for Engineering Education (ASEE) will also meet in New York, October 14–15. Joint activities have been arranged and headquarters will be at the Hotel Statler.

First meetings will be held by committees and divisions of the ASEE on October 14. The ASEE general council will hold a dinner and an evening meeting.

A conference of ECRC and ECAC will be held in the morning of October 15 and will be followed by a joint ASEE-ECPD luncheon. The ECRC and ECAC conference will be continued in the afternoon. The ECPD executive committee will meet in the evening.

The ECPD conference will begin on October 16 with a discussion on accrediting. General A. G. L. McNaughton, chairman, Canadian Section, International Joint Commission, will speak on "Water Problems on the Canadian Boundary" before a joint ASEE-ECPD luncheon meeting. A symposium on supply and demand for engineers, in co-operation with the Engineering Manpower Commission, Engineers Joint Council, will be held that afternoon. The annual dinner, which will be a joint ECPD-ASEE affair, will feature a report of ECPD Chairman L. F. Grant and an address by a speaker to be announced later.

Final meetings of the conference will be held by ECPD committees on the morning of October 17.

Findings of Research Program on Radiological Decontamination Announced

Dr. Foster D. Snell, president of the consulting chemical firm of Foster D. Snell, Inc., made the first public announcement recently of the results of a 2-year research program on the cleaning of surfaces contaminated with radioactive debris. Such decontamination is necessary in the many laboratories working with radioactive isotopes and will be necessary on a large scale in case of explosion of an atomic bomb at or near a populated area. When an atomic bomb is exploded, the smoke and dust in the air take up the radioactive materials. Then such radioactive smoke and dust can be dispersed by the wind over wide areas before settling.

The results of the study show that the major part of the decontamination can be done by the housewife if necessary, using largely materials she has on her kitchen shelf, products purchased at her corner grocery or supermarket. Some surfaces, notably plaster, require special treatment.

The nature of the fission products depends on the time which has elapsed since the explosion and the type of the bomb used. Chemically the atoms present are largely in the group from yttrium to europium, usually called rare earths. For the investigation a group of such fission products supplied by the Oak Ridge National Laboratory was incorporated into a synthetic soil representative of the dirt formed by analysis in the air over industrial cities and containing dozens of components. This was applied to such diverse types of surfaces as tin, glass, cement, gypsum plaster, unpainted and painted wood, cotton cloth, and even the shaved skin of rabbits.

After the deposit had been allowed to dry, it was "deterged" by standard technics using commercial soaps, light-duty syndets (synthetic detergents), and heavy-duty detergents. The degree of contamination and removal was measured with the Geiger counter. It was found that heavy-duty syndets were generally more effective than either light-duty syndets or soap. That proved to be the clue to efficient removal of fission products. There is a class of chemical compounds known as sequestrants which have the property of "locking up" in the compound many elements such as calcium and magnesium and the rare-earth elements produced as fission products. While there are several of these sequestrants including ethylene diamine tetra-acetic acid, pyrophosphates, tripolyphosphates, and even citrates, the most economical to use is Calgon, a modified form of sodium hexametaphosphate. When two parts of this harmless chemical are mixed with one part of either soap or syndet and applied in 1-per-cent solution in water, removal of the radioactive contaminant from nearly all surfaces was nearly complete. An exception was formed in the case of gypsum plaster where removal by plain water was better than with any cleaning agent. Thus radiological decontamination of any city or town after an atomic burst will present special problems requiring close technical supervision. As a typical example, water removed 47 per cent of the contamination from frosted glass, 1-per-cent solution of soap removed 81 per cent, but in admixture with two parts of Calgon, thus using only one-third as much soap, 98.8 per cent was removed. In general, the harder and smoother the surface, the easier it is to decontaminate. With the exception of plaster, decontamination to better than 90 per cent offers no great difficulties if the appropriate materials are available.

The results of the study were given in papers presented by Dr. Snell before the 26th International Congress of Industrial Chemistry, Paris, France, June 18–29, 1953, and in the Society of Chemical Industry, Nottingham, England, July 20–24, 1953, and to be presented before the 13th International Congress of Pure and Applied Chemistry, Stockholm, Sweden, July 29–August 4, 1953.

Telephone Answering Device Takes Calls and Gives Messages

An automatic telephone answering device which can take incoming calls and give a caller a message has been developed by Bell Telephone Laboratories.

When the device is connected to a telephone, the user can record a message up to 30 seconds in length, which can be checked, erased, or changed as desired. The telephone is used to make the recording. Before the office is left, the telephone is switched to the automatic machine, which takes over in the user's absence.

In response to an incoming ring, the machine answers with the prerecorded message after which it switches to a recording condition. Tone signals tell the caller when he can proceed with his message. After 25 seconds, tones are transmitted to indicate that the recording period is almost at an end. About 3 seconds later, the machine releases the line and resets for the next call. Maximum time for an incoming recording is 28 seconds. The recording mechanism has a capacity of 20 received messages.

All recording and reproducing is done by means of magnetic neoprene drums. Playback of the messages is through the telephone receiver.

Westinghouse Establishes Engineering Professorship

The educational Foundation of the Westinghouse Electric Corporation recently undertook to sponsor a George Westinghouse Professorship in Engineering Education at the School of Engineering of The Pennsylvania State College. Intended to organize and develop an effective program of "teaching engineering teachers to teach," this grant will enable the School of Engineering to subsidize: 1. a scientific analysis of engineering educational methods and techniques; 2. a re-evaluation of educational standards and objectives; and 3. a modern, up-to-date program of scientific instruction.

With a critical shortage of engineers in all fields, the broadening of science, and the resulting need for educational consolidation, the new program of engineering education, under the direction of Eric A. Walker, dean of the Engineering School, will engage a scientist to "bring engineering knowledge to a common denominator of understanding."

"The average engineering teacher," Dean Walker maintains, "knows little or nothing about the theories of teaching. He has never studied the learning process nor has he carefully considered how he can transfer understanding effectively from textbook to student. Preparing himself either with advanced scientific degrees or by working in industry, he extends by the first approach, his knowledge of physical science and, by the second, learns how to work as a member of a team and gains administrative experience. Yet, neither of these courses teaches him to teach. In fact, by carrying him further from the level of abstraction he attained as a student, he recognizes less clearly the difficulties students have in understanding engineering principles.

"Similarly," Dean Walker continues, "the engineering student, though taught to think in the shorthand of equations, a limited but peculiarly precise manner of thinking, is equally ignorant of the basic concepts of engineering. Exposed to the individual teaching methods of various teachers and to the barrage of formulas, theorems, and equations, too often memorized without being understood, he cannot codify the isolated studies of his education. He has come to confuse facts with knowledge and, despite his training in inductive versus deductive reasoning, he cannot inductively determine the scientific bedrock upon which his engineering education rests and his livelihood depends.

"Living in an engineering age," the dean declares, "we must take the kinks out of engineering education. By simplifying and

correlating our technical studies in all fields of engineering and centralizing our instruction about the basic sciences, we can accelerate our engineer's education, systematize his thinking, and graduate more and better-trained engineers to fill the vacancies in government and industry.

"Assuming this challenge," Dean Walker predicts, "though our results may be some time in coming, Penn State's experiment in engineering education is expected to revitalize scientific instruction, and perhaps, to develop some basic methods of education itself."

Employment Co-ordination Urged for Veterans by EMC

In re-emphasizing the Engineering Manpower Commission's (EMC) program to facilitate employment contact between industry and the engineer returning from military service, EMC would like to remind employers that industrial recruiting will not be permitted by the Department of Defense at military separation activities.

In a pamphlet, "Going Back To Civilian Life," recently published by the Department of Defense for distribution to each person being separated from military service, the following is quoted from the section dealing with employment:

"Veterans who are graduates of colleges or technical schools and who wish employment in fields of their training should consider contacting the placement bureaus of their schools."

In view of these statements it is even more important that companies interested in engineering graduates being separated from the military, utilize the services of college placement bureaus and the Engineering Societies Personnel Service, Inc. EMC will continue to spread the word, through all available channels, to engineering graduates now in service.

NSPE Declines Invitation to Join EJC at This Time

Too many unresolved problems is the reason given by the National Society of Professional Engineers' (NSPE) Board of Directors for failing to accept, at this time, the Engineers Joint Council's (EJC) invitation for the society to join that group. The Board called for representatives of NSPE to offer to meet, as soon as possible, with representatives of EJC to discuss new approaches to unity of the engineering profession. NSPE President John D. Coleman pointed out that an early meeting is desirable in view of NSPE's next Board meeting to be held in November at which time the NSPE Board will further consider the question. The decision was made at NSPE's 19th Annual Meeting in Daytona Beach, Fla., June 18–20, 1953.

The Board, representing NSPE's 39 state societies, pointed out that unity of the profession is of paramount importance but that the means for accomplishing it needed further clarification. Board members stated that more information was necessary concerning such items as individual membership in the enlarged EJC; the function of NSPE as a member; the degree to which NSPE's programs would be affected; and similar matters of concern.

The recently reorganized EJC has extended invitations to several engineering societies, one of which was NSPE, to become members. The society has had an observer at meetings of the proposed unity group since that time.

Railway Congress Discusses Latest Equipment and Operations

Railroad officials and transportation specialists from the United States and Latin America and other foreign countries met in Atlantic City, N. J., June 21–26, 1953, to see a $20,000,000 exhibit of the latest in railroad equipment and to discuss developments in operations.

During that week, meetings were held by the Pan American Railway Congress, the member roads of the Association of American Railroads (AAR) and the American Short Line Railroad Association, the AAR Mechanical and Purchase and Stores Divisions and Electrical Sections, and the Railway Supply Manufacturers Association.

The Electrical Section of the AAR held its meetings from June 24 to June 26 and included reports from its technical committees.

The first session of the section meetings on June 24 included reports on car air-conditioning and refrigeration, corrosion-resisting materials, automotive and electric rolling stock, electric heating, and motors and controls.

The second session on June 25 discussed reports on application of radio and communication systems to rolling stock, car electric equipment, power supply, railway electrification, safety, and electrolysis.

Wiring diagrams, wire, cable, and insulating materials, repair shops, welding and cutting, and illumination were topics discussed on June 26.

Speakers at the Electrical Section meetings were H. T. Cover, chairman, Mechanical Division, assistant vice-president, Pennsylvania Railroad; J. H. Aydelott, vice-president in charge of the Operations and Maintenance Department, AAR; and C. A. Williamson, electrical engineer, Texas and New Orleans Railroad and chairman of the section.

Walter T. Wells Named Winner of Marston Medal

Walter T. Wells, chairman of the board of directors of the Lane-Wells Company, Los Angeles, Calif., was named the 15th winner of the Marston Medal for achievement in engineering at the commencement exercises of Iowa State College, June 12, 1953. The Marston Medal is awarded to an engineering alumnus from Iowa State College in recognition of achievement in engineering. The award was established through the inspiration and generosity of the late Anson Marston, who was professor of civil engineering from 1892 to 1920, dean of the Division of Engineering from 1904 to 1932, and dean emeritus at the time the award was established in 1938.

This year's medalist, Walter T. Wells, was born in Marathon, Iowa, June 6, 1886, and graduated from Iowa State College in 1910. He founded the Lane-Wells Company in 1932 and the company has grown to be one of the largest oil field service organizations in the world. Mr. Wells invented the conductor cable which resists high underground temperatures. In 1948 Mr. Wells founded the Superweld Corporation, a company engaged in electric furnace brazing and technical metallurgical processes. He has been honored for his achievements by the Chicago Alumni Association and Eta Kappa Nu.

New Officers Elected at ASTM Annual Meeting

New officers of the American Society for Testing Materials (ASTM) were elected at the society's annual meeting in Atlantic City, N. J., June 28–July 3, 1953.

Leslie C. Beard, Jr., assistant director of Socony-Vacuum Laboratories, New York, N. Y., was elected president for 1953–54. Mr. Beard had previously served as a director and vice-president.

Elected vice-president for a 2-year term was Claire H. Fellows, director, Engineering Laboratory and Research Department, Detroit (Mich.) Edison Company. Chosen to serve on the ASTM Board of Directors for a 3-year term were Neil A. Fowler, director of sales and research, General Box Company, Des Plaines, Ill.; Richard T. Kropf, vice-president, Industrial Thread Division, Belding Heminway Corticelli, New York, N. Y.; Theodore E. Olt, director, Research Laboratories, Armco Steel Corporation, Middletown, Ohio; John R. Townsend, director of materials and standards engineering, Sandia Corporation, Albuquerque, N. Mex.; and Kenneth B. Woods, associate director, Joint Highway Research Project, and professor of highway engineering, Purdue University, Lafayette, Ind.

Industrial Design Congress Set for Paris in September

An Industrial Design Congress will take place in Paris, France, September 14–17, 1953. Previous congresses were held in London, England, in 1951 and Darmstadt, Germany, in 1952. The general title of the Paris congress will be "Industrial Design: Attractiveness, Welfare and Source of Wealth."

A large number of European industrialists, industrial designers, engineers, and architects are expected to attend the congress, which aims at promoting industrial design in Europe by proving that it is a very important factor of productivity.

Several speakers from the United States are expected to be on the program. The organizers are also interested in attracting an American audience because they feel that exchanges of views between American and European industrialists operating successful design policies should be extremely stimulating for their respective economies.

Inquiries about the congress should be addressed to the Secretariat General, Congrès International d'Esthétique Industrielle, 28 Rue Saint-Dominique, Paris 7, France.

Electric Energy, Inc., Wins Charles A. Coffin Award for 1952

Electric Energy, Incorporated, one of the nation's youngest electrical utility companies with only a single customer, was presented the Charles A. Coffin Award, the electrical industry's top honor, for outstanding achievement during 1952.

Ralph J. Cordiner, president of the General Electric Company, made the presentation to J. W. McAfee, president of Electric Energy, Incorporated, during the Edison Electric Institute's 21st annual convention, Atlantic City, N. J. B. L. England, president of the institute, was in charge of the special ceremony.

The award-winning company, established in 1950 to supply electric power to the Atomic Energy Commission (AEC) project at Paducah, Ky., was selected by a committee appointed by the institute, which considered the achievements of more than 30 companies before narrowing the selection to five finalists, including Electric Energy, Incorporated.

Selection of Electric Energy, Incorporated, was based on the vision, initiative, and courage in pioneering action by a group of electrical utility companies to handle power loads which are larger than one company could handle alone. The award also gives recognition to the company's achievement in constructing new generating facilities needed to bring to the AEC plant site the large amounts of power needed to sustain the rush construction program.

The citation of the judges reads in part: "For its brilliant and bold conception, for its marked demonstration of forceful industry leadership, for its contribution to the national defense, its superb example of cooperative enterprise, its demonstration that American industry can take the long view of adapting itself to the new age, and for its eminence as a prototype of an electrical utility organization that can and will take on enterprise of great magnitude in the public interest without subsidization by the taxpayers of the nation, Electric Energy, Incorporated, is hereby declared the winner of the Charles A. Coffin Award of 1952."

The Charles A. Coffin Award is presented by Ralph J. Cordiner, center, president of General Electric Company, to J. W. McAfee, president of Electric Energy, Incorporated. At left is B. L. England, president of Edison Electric Institute

Important Trends and Conclusions Brought Out at ASEE Meeting

The American Society for Engineering Education (ASEE) held its 61st annual meeting at the University of Florida, Gainesville, June 22–26, 1953, at which 235 speakers and 2,000 delegates engaged in 133 conferences and 7 general meetings. Topics discussed included the greater responsibility of the engineer, problems of unionization, the inadequate number of teachers, federal support of research, and the raising of the accreditation standards of engineering schools.

Dr. Linton E. Grinter, dean of the graduate school of the University of Florida, was elected president for the coming year on June 22, with Dean B. R. Teare (F '42), Carnegie Institute of Technology, as vice-president, and George Wright Franham, publisher, as treasurer.

The ASEE endorsed the recommendation of its Committee on the Evaluation of Engineering Education that many engineering curricula do not adequately prepare their students. It was resolved by the committee, of which Dr. Grinter is chairman, that a substantial raising of the minimum accreditation standards be sought by the Engineers' Council for Professional Development.

The current president, W. R. Woolrich, dean of the University of Texas College of Engineering, spotlighted the dangers to the engineering profession of unionization, inadequate compensation, military expediency, and the enticement of the ever-diminishing supply of engineering teachers by industry. To study the last problem, a special Committee on Instructional Manpower has been appointed, Dean Woolrich said.

D. S. Bridgman, American Telephone and Telegraph Company, and chairman of the ASEE Manpower Committee, expressed his concern over the shortage of graduate students in the engineering field, despite the nearly adequate number of students receiving bachelor's degrees.

K. B. McEachron (F '37) consultant on professional employee relations for the General Electric Company, told of the threat to existing professional societies posed by the growth of the Engineers and Scientists of America (ESA). The ESA, a federation of labor unions, embodies principles which are, in many respects, inconsistent with those of the professional engineer, he said. The engineer must be free to deal individually with his employer, since the interests of his company will be largely his interests, and the confidential nature of many company policies and decisions precludes their being brought into the nation-wide area of militant collective bargaining, Dr. McEachron stated.

The report of the Engineering College Research Council (ECRC) of the ASEE, edited by Virgil E. Neilly (AM '49), secretary of the ECRC, stated that American engineering colleges are spending $65,000,000 on 7,500 projects in 103 schools this year. Participating in these projects are more than 13,000 teachers, students, and engineers.

Federal support of research endangers the future of private educational institutions, warned Dr. Eric A. Walker (F '47), dean of the School of Engineering, Pennsylvania State College, and president of the ECRC. The budgets of our schools may become so inflated that if government support were to be withdrawn suddenly by a Congressional economy move, they may find themselves on the verge of bankruptcy, he said.

Joseph W. Barker (F '30), president of the Research Corporation of New York, and Dr. Carl F. Prutton, Mathieson Chemical Corporation, also spoke on this topic.

Harold L. Hazen (F '43), dean of the graduate school of the Massachusetts Institute of Technology, said that research programs in the engineering colleges, by invading the ivory-tower attitudes of the purely academic world, give their students and faculties the best chance for contributing creatively to the profession later.

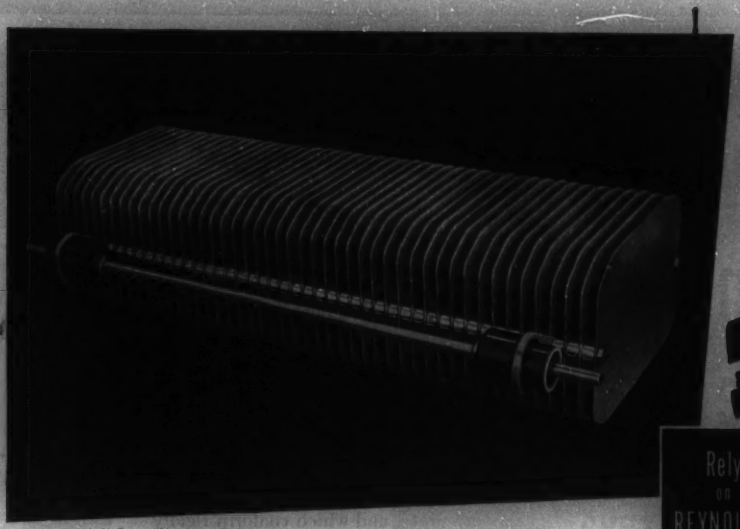
President Harry S. Rogers of Brooklyn Polytechnic Institute received the 26th Lamme Award for leadership in the engineering profession and educational world, and for his services to the government during the last war. The George Westinghouse Award for recognition of young engineering teachers was given Professor Frederic Obert, Northwestern University. The first two honorary memberships ever awarded by the ASEE were conferred upon Dean A. A. Potter, Purdue University, and Dean Emeritus Harry P. Hammond, Pennsylvania State College.

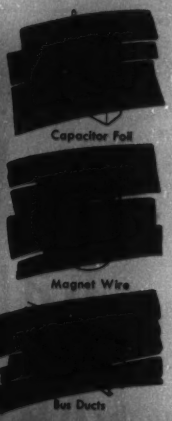
European Engineers to Hold International Congress in Rome

An International Congress of Engineers, organized under the auspices of the International Federation of National Associations of Engineers (FIANI) by the National Association of Italian Engineers and Architects (ANIAI), will be held in Rome, Italy, October 8–11, 1953.

The general theme of the congress will be "The Preparation of the Engineer for His Role in Society." Various aspects of this theme to be discussed will include the role of the engineer and the development of his professional techniques, his place in the economy, administration, public life, and social structure of the nation, his role in professional groups, and his role in the growth of Europe. Various technical and sight-seeing trips have been arranged for the week after the congress, October 12–15.

Engineers interested in detailed information about the congress should write the Executive Committee, FIANI, care of ANIAI, 90 Via Terme Diocleziana, Rome, Italy. Members of the AIEE are invited to take part in the congress.





Rely on REYNOLDS : Depend on ALUMINUM in Electrical Applications

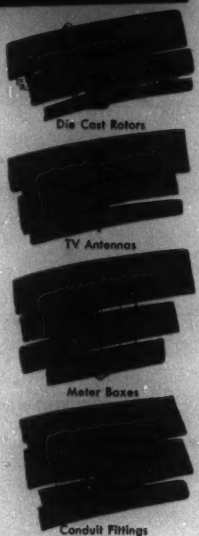
Aluminum Cuts Costs, Weight and Maintenance in AAF "Electro-Cell" Air Filters

Collector plate assemblies for electronic air filters (like the American Air Filter Company unit above) are definitely superior when aluminum is used in their construction. For example, the lightness of aluminum makes these collector plates easy to remove for cleaning and recoating —a distinct sales advantage over the old time heavy weight filter plate materials.

Furthermore, the lightweight of aluminum permits easy lifting and precision alignment of assemblies in manufacture.

Aluminum readily lends itself to a slight etching process which provides a capillary surface for the retention of a heavy film of oil for trapping impurities out of the air. This process also tends to round the edges of the plates which minimize electrical loss.

Important, too, is the low cost of aluminum. This makes it practical to keep a spare set of assemblies on hand, cutting down on the time the filter has to be out of service. Thus it is easy to see how the unique advantages of aluminum by Reynolds can be used to cut costs, weight and maintenance expense in electrical equipment.



Call on Reynolds Electrical Engineering Service for Help on Your Problems

Reynolds engineers will conduct meetings with your men to provide them with the latest information on electrical applications of aluminum. Also write for a complete index of design and fabrication literature. Reynolds Metals Company, 2541 South Third Street, Louisville 1, Kentucky.

"Mister Peepers" returns September 13th on NBC-TV

REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

What Can You Expect?

...from your **POWER FUSES**

Full Range Protection?

—protection against low current faults as well as high, under all conditions of recovery voltage

Accurate Protection?

—time-current characteristics which are completely accurate, and which conform rigidly to published curves

Dependable Protection?

—operating characteristics unchanged by vibration, aging, atmospheric conditions, surges, or fuses blowing on other phases

S&C POWER FUSES have all these characteristics. Their lifelong accuracy permits systems to be planned with close multistep coordination between protective devices . . . brings a **NEW ERA** of system protection . . . **NEW THINKING** about how fuses can be used to better advantage, and **NEW CONCEPTS** of the place for fuses in protecting lines and equipment.
Can we send you further information?

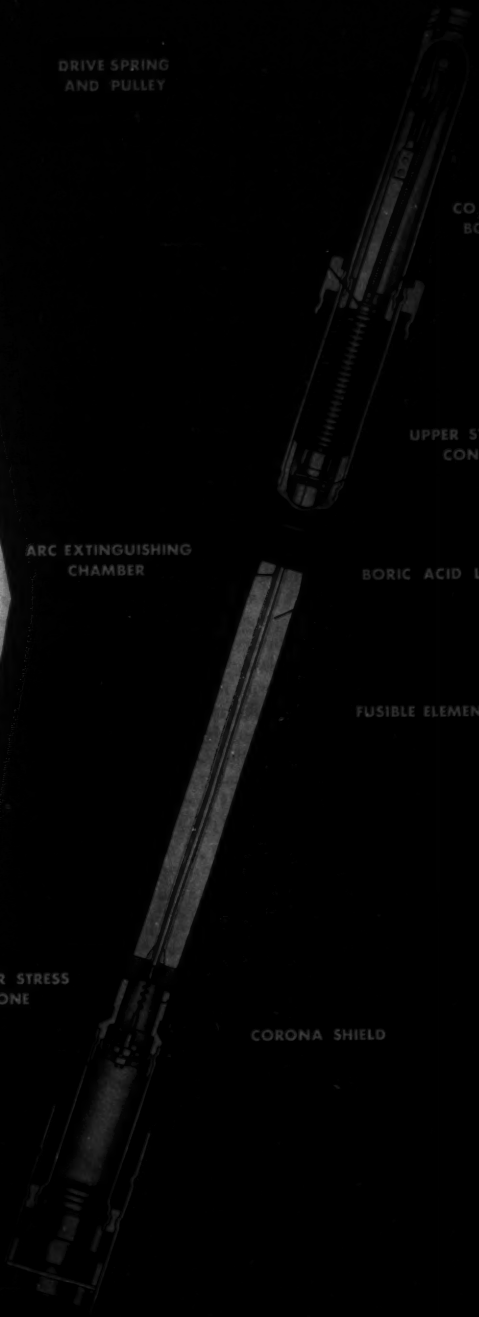
S&C ELECTRIC

ol. 72
1953

S&C FUSES ARE YEARS AHEAD IN DESIGN

The days when baling wire and a fibre tube made an acceptable fuse passed more than a generation ago . . . although many such fuses are still on the market!

Engineering techniques reflected in S&C Power Fuses mean accuracy and dependability equal or superior to the best-engineered protective devices of other types. Would you like to know more? Write for detailed information.



Swedish Steel Cored Aluminium Conductors

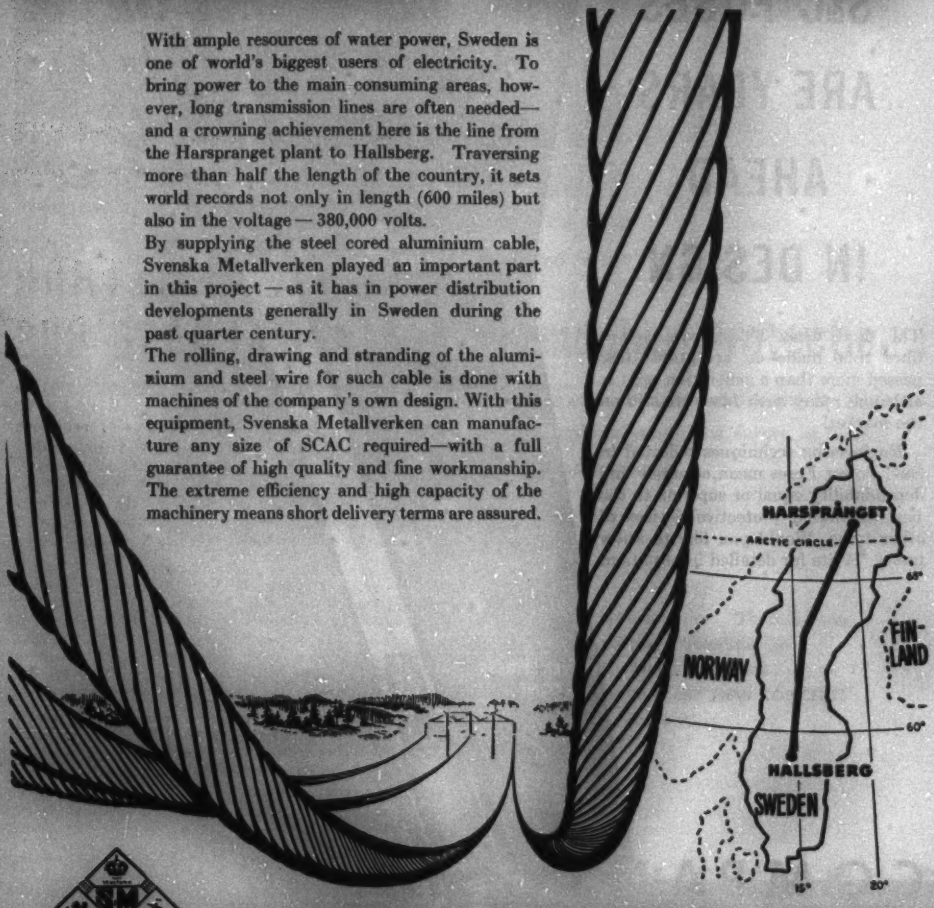
(ACSR)

FERAL CABLE

With ample resources of water power, Sweden is one of world's biggest users of electricity. To bring power to the main consuming areas, however, long transmission lines are often needed—and a crowning achievement here is the line from the Harspranget plant to Hallsberg. Traversing more than half the length of the country, it sets world records not only in length (600 miles) but also in the voltage — 380,000 volts.

By supplying the steel cored aluminium cable, Svenska Metallverken played an important part in this project — as it has in power distribution developments generally in Sweden during the past quarter century.

The rolling, drawing and stranding of the aluminium and steel wire for such cable is done with machines of the company's own design. With this equipment, Svenska Metallverken can manufacture any size of SCAC required—with a full guarantee of high quality and fine workmanship. The extreme efficiency and high capacity of the machinery means short delivery terms are assured.



AB SVENSKA METALLVERKEN

Sales office: Stockholm 16, Sweden

The world's longest power transmission line, with a tension of 380,000 volts, from Harspranget to Hallsberg in Sweden, has six Feral Cables.

SILVER-PLATED CONTACT SURFACES on treated aluminum channel conductors. Special equipment (in background) enabled G-E chemists and engineers to perfect speedier automatic process for better quality control.

SILVER-PLATING BY A NEW G-E METHOD ASSURES TOP QUALITY ISOLATED-PHASE BUS

LIGHTWEIGHT ALUMINUM conductors make handling and installation easier. These sections of 8000-ampere bus are easily handled by one man as they leave silver-plating process.

Process improves electrical joints between aluminum conductor sections

An exclusive process for silver-plating aluminum—developed at General Electric's Switchgear Product Laboratory in Philadelphia—has greatly improved use of aluminum as an electrical conductor. Installation of the new, light-weight conductors can now be handled in the field in the same manner as the installation of copper conductors.

Heart of the new method, as perfected by G.E.'s engineers and chemists, consists of avoiding entrapment of alkali in the zinc deposit on the aluminum, thus giving a closer bond between the two metals . . . one that will not deteriorate with time or temperature. Previous methods left a residual coating of alkali under the silver which formed blisters and caused marked deterioration.

Use of the new channel conductors with silver-plated contacts reduces weight of isolated-phase buses by 20%. Moreover, the use of aluminum permits engineering flexibility in the design of buses, depending upon availability of materials. General Electric Company, Schenectady 5, N. Y. 871-2

You can put your confidence in—

GENERAL ELECTRIC

Economy and Practicality are by-words with Gibson CONTACT RIVETS

Rivets cost less than other forms of electrical contacts and are easier to assemble . . .

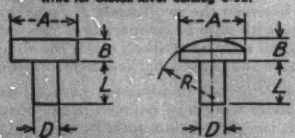
Gibson contact rivets are often the most appropriate and economical contacts for relays, switches, instruments and other applications involving small or moderate currents.

They are easy to install, are promptly supplied in standard or special sizes and shapes, and can be conveniently attached to springs or other supports at the Gibson plant — using supports furnished either by Gibson or the customer.

Moreover, Gibson contact rivets are readily available in fine silver, coin silver, or any electrical contact material capable of being cold-formed. Gibsiloy A-3, a case in point, combines all the advantages of silver with tougher wear resistance and reduced tendency to "freeze."

Let Gibson engineers recommend the best Gibson contact rivet for your needs. For rivet quotations, please submit dimensions (as shown below) and quantity desired.

Write for Gibson Rivet Catalog C-521



A = head diameter D = shank diameter
B = head thickness L = shank length
R = radius of face

CONTACT GIBSON FIRST

Gibsiloy ELECTRICAL CONTACTS

Manufactured by GIBSON ELECTRIC COMPANY

8348 FRANKSTOWN AVE., PITTSBURGH 21, PA.

INDUSTRIAL NOTES ....

General Electric News. The General Electric Air Conditioning Division recently announced that part of its home heating and cooling department would be transferred from Bloomfield to Trenton, N. J., in a move to expand production facilities and meet increasing demand for home air conditioning. F. J. Poppelen, general manager of the Air Conditioning Division, said that the move to Trenton will allow the Division to utilize facilities vacated by the home heating and cooling department for expansion of production of packaged air-conditioning units and water coolers for commercial and industrial use, and the new General Electric packaged heat pump.

Increased electronic tube service to the Midwest was spotlighted June 11, as the General Electric Company formally opened its new tube warehouse, largest in the world, at 3800 North Milwaukee Avenue, Chicago, Ill. The $875,000 structure has almost 100,000 square feet of floor space. It also serves as headquarters for the company's central regional sales organization for electronic tubes. Warehouse manager is John A. Cavaliere, while J. J. Shafter is supervisor of commercial service. Walter J. Fitzpatrick heads the replacement sales organization and Roger F. Long heads the original equipment sales organization. The new structure will service all tube types, industrial and transmitting, receiving, and television picture tubes. It is the third recent major addition to the General Electric tube warehouse system, following establishment of eastern and southern regional warehouses at Clifton, N. J., and Owensboro, Ky., respectively.

Square D Opens New Plant. Official opening of the Square D Company's new Seattle, Wash., plant to serve the Pacific Northwest has marked a great stride in Square D's development in that section. In conjunction with the new plant, it has been announced that new sales offices in Portland, Oreg., and Spokane, Wash., have been set up. L. G. Macchtlen, sales manager of the western division, also has announced that, in line with the company's expansion efforts, a scholarship fund has been set up at the University of Washington at Seattle.

TV Boom Predicted for Canada. Philco Corporation of Canada, which has conducted manufacturing operations in rented quarters in Toronto, Ontario, since 1929, is now erecting a modern, 80,000-square-foot plant at Don's Mills, Toronto suburb, in which it will manufacture television receivers, radios, and other electronic equipment. The plant is expected to be occupied early in 1954. Dr. Courtnay Pitt, vice-president of finance, has predicted that sale of television receivers in Canada will be at least 2½ times as great in 1953 as last year.

Kuljian to Prepare Site Adaptations. The Corps of Engineers, United States Army, has awarded contracts to the Kuljian Corporation, engineers and constructors, Philadelphia, Pa., to prepare site adaptations for double-cantilever maintenance hangars at 23 Air Force bases. The double-cantilever-type hangar originally was developed for the Air Force by the Kuljian Corporation under contract with the Corps of Engineers, from standard Air Force designs, to house airplanes with large wing spreads. The 92-foot roof supports, cantilevered from central columns, provide uninterrupted space both at front and rear of the hangar for servicing of the largest aircraft. The new hangars will be adapted to various temperatures, snow and wind conditions. For northern bases, the hangars are being designed for 40-pound roof loading and 20-degree temperature. Southern locations call for 20-pound roof loading and a minimum temperature of 20 degrees.

New RCA Plant. The RCA Victor Division of the Radio Corporation of America has announced the purchase of ground to construct a new plant at Findlay, Ohio, for the manufacture of electronic component parts for radio and television home receivers. Present plans call for the building of a modern, single-storied structure providing approximately 150,000 square feet of floor space, according to Richard T. Orth, vice-president in charge of the RCA Tube Department, which will operate the plant.

Ferro to Manufacture New Frit. The Ferro Corporation will manufacture and sell a new frit especially developed by the Du Pont Company for the coating of aluminum, according to an announcement made by C. D. Clawson, Ferro president. Du Pont researchers have developed a method of meeting the lower melting requirements of aluminum enamel coating, about 1,000 degrees Fahrenheit, as compared to standard frits, used on steel, which are processed at around 1,500 degrees Fahrenheit.

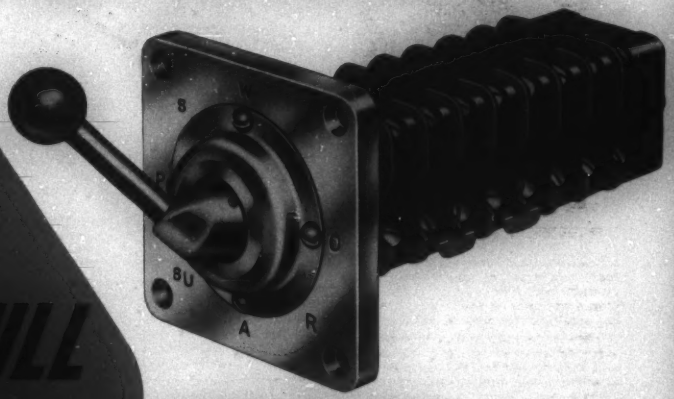
Clark Controller Buys Plant. Robert H. Hoge, president of the Clark Controller Company, has announced the acquisition by outright purchase of Fuller Johnson Corporation, a company which in turn owns and operates American Electric Switch Corporation and Good Roads Machinery Corporation, all of Minerva, Ohio. American Electric Switch manufactures safety switches and electric service entrance equipment, and will continue to make these items, none of which are made or sold at present by Clark Controller Company. It is not now intended that Electric Switch will make any apparatus made by Clark. Good Roads Machinery makes a line of road machinery accessories and also large leaf collectors which pulverize leaves. The sales organizations and distributors of both firms will be maintained as at present. Clark will further the sales of Electric Switch products through its own sales and distribution

(*Continued on page 22A*)

This is IT!

ONE POINT of CONTROL for ANY APPLICATION

with the ARROW AH HART



PUSH-PULL SELECTOR SWITCH

SAVES APPARATUS AND SPACE... PROVIDES SIMPLIFIED CONTROL

COMPARE
A 2-SPEED REVERSING LATHE
8 OPERATIONS

involving spindle motor, coolant motor, brake and a "Safe" position.

CONVENTIONAL CONTROLS	AH "PPS"
6 Magnetic Units	1 Magnetic Unit
7 Push Buttons	1 "PPS" Switch
11 UNITS...	SAVED

COMPARE
A DRY CLEANING MACHINE
8 OPERATIONS

involving fan, pump, washing and extractor motors and "Automatic" and "Off" positions.

CONVENTIONAL CONTROLS	AH "PPS"
6 Magnetic Units	3 Magnetic Units
1 Timer	1 Timer
14 Push Buttons	1 "PPS" Switch
16 UNITS...	SAVED

COMPARE
AN AUTOMATIC BAKELITE PRESS
8 OPERATIONS

involving a choice of jogging for each separate function or completely automatic cycling.

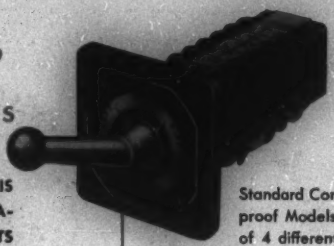
CONVENTIONAL CONTROLS	AH "PPS"
6 Magnetic Units	2 Magnetic Units
1 Timer	1 Timer
9 Push Buttons	1 "PPS" Switch
12 UNITS...	SAVED

THE SIMPLE ANSWER TO YOUR COMPLEX CONTROL PROBLEMS

REDUCES CONTROLS REQUIRED • SAVES SPACE and WEIGHT • IMPROVES LAYOUT and APPEARANCE • ADDS FLEXIBILITY, VERSATILITY • PROVIDES MAXIMUM SPEED, EASE and SIMPLICITY of OPERATION • FOOLPROOF, PROTECTS OPERATOR and EQUIPMENT • ASSURES PEAK PERFORMANCE

TURN THE PAGE FOR AN ELECTRICAL DESCRIPTION and OPERATIONAL FEATURES

Control TAILORED TO YOUR EXACT NEEDS



STANDARD CONSTRUCTION WITH CAST LEVER HANDLE ILLUSTRATED

Standard Construction or Oil and Weather-proof Models are available with a choice of 4 different Handle Types.

— THE ARROW-HART "PPS" SWITCH IS CUSTOM BUILT TO YOUR SPECIFICATIONS FROM STANDARD COMPONENTS

What the "PPS" does

- **A SINGLE "PPS" UNIT PROVIDES SINGLE-POINT CONTROL . . .** involving practically any desired circuit arrangement.
- **THE "PPS" REDUCES THE NUMBER OF CONTROLS REQUIRED**
  - — because it is the *ONLY* pilot device required for practically all installations.
  - — because the *"PPS"* makes a single *MAGNETIC* control (starter, contactor etc.) do the work of many.

Here IS THE BASIC OPERATING PROCEDURE SIMPLE AS A-B-C

A **PUSH and TURN TO SELECT . . .** The operator must first push the handle — opening all circuits and disconnecting all controls. The handle can then be turned to any desired position; this selects the correct circuits for the required function. Any number of unwanted, intermediate functions can be passed without energizing their circuits.

B **PULL TO START . . .** With the handle in the desired position, the handle is pulled to start the operation — the same as actuating a conventional "Start" button.

C **PUSH TO STOP . . .** Pushing the handle immediately stops the operation. "PPS" single-point control is safer in emergencies because there is never a delay to find the right button.

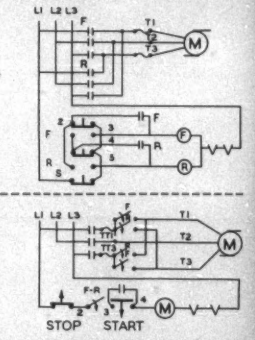
How the "PPS" works

To explain the action of the "PPS", let us look at an example; the simplest possible is the standard reversing of a motor. This example will show how the required number of magnetic units is reduced and how single-point control will serve for any number of operations.

While your own actual control application may be more complex than this example, it will simply entail using enough additional circuits to accomplish the required combinations of load and control hook-up.

CONVENTIONAL CIRCUIT . . . This diagram shows the familiar type of reversing circuit. 3 push buttons and 2 magnetic units are required.

"PPS" CIRCUIT . . . Here the Rotating Cam Sections of the "PPS" select the circuit, and the Momentary Contact Sections operate the motor as desired. The diagram also shows the symbol used for "Stop" by pushing and "Start" by pulling. Only 1 *magnetic unit* and 1 pilot device, (the "PPS"), are required.



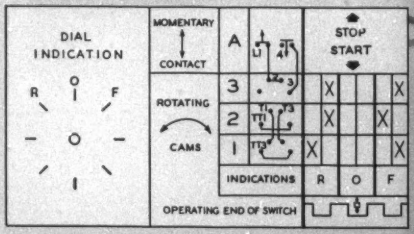
Tested, Accepted...and Acclaimed

Leading manufacturers and designers of new equipment, plant engineers and maintenance men, and operators everywhere who have worked with and know the "PPS" are universally sold on its benefits. Although it is revolutionary and relatively new, the "PPS" has been thoroughly tested on innumerable installations and found OUTSTANDING.

IT WILL PAY YOU TO KNOW MORE ABOUT THE ARROW-HART "PPS" SWITCH

This new concept in motor control can help solve your present tough control problems . . . and help you build peak performance into your new designs. Use the coupon, attached for your convenience, to send for completely descriptive literature including a sample Target Sheet for plotting your circuit requirements.

THE "TARGET SHEET" . . . shown here in abbreviated form, is the means by which your control requirements are translated into a diagram for the construction and wiring of a "PPS" Switch. A wiring diagram strip shield is visible from the top of every switch you buy indicating the terminals and all internal and external connections on the "PPS".



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AH

Industrial Control Division
THE ARROW-HART & HEGEMAN ELECTRIC CO.
103 Hawthorn Street, Hartford 6, Conn.

Please send me ☐ *complete information about the Push-Pull Selector Switch.* ☐ *Also the A-H Design Story folder featuring Type "RA" Magnetic Motor Controls.*

NAME _____

CO. NAME _____

POSITION _____

ADDRESS _____

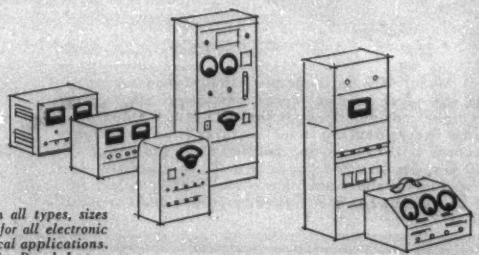
CITY _____ ZONE _____ STATE _____

ARROW-HART
INDUSTRIAL CONTROL DIVISION
THE ARROW-HART & HEGEMAN ELECTRIC COMPANY
HARTFORD 6, CONN., U.S.A.

WESTON

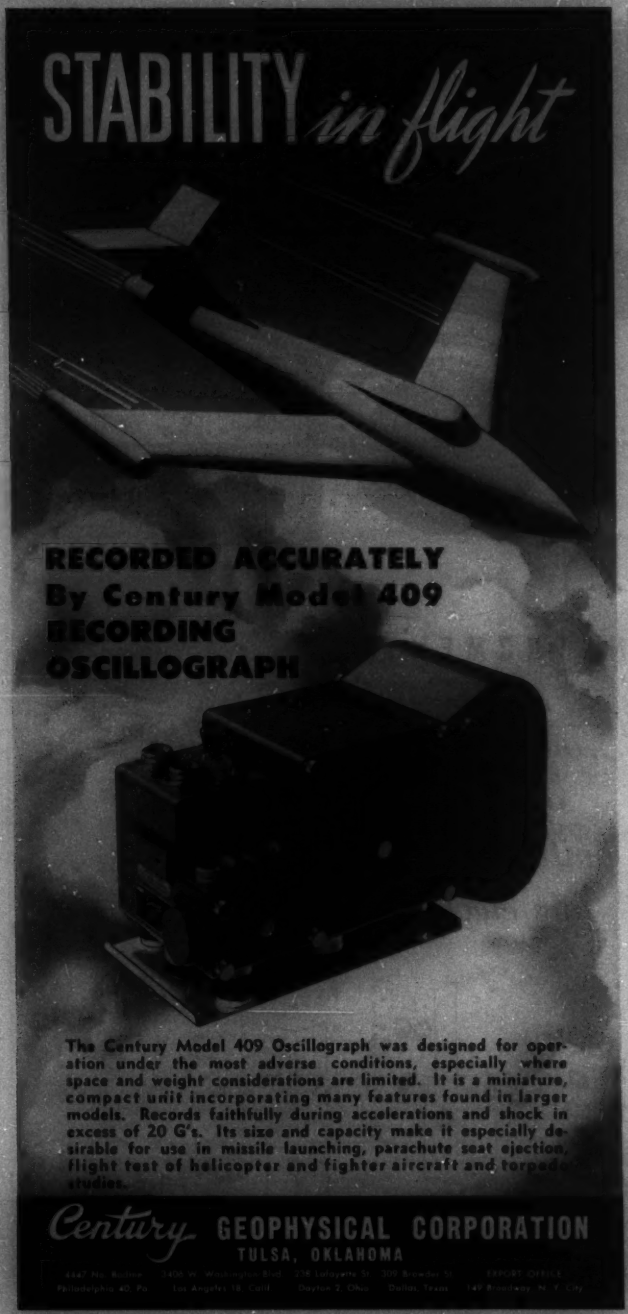
PANEL INSTRUMENTS...

...outward evidence of the high quality built within fine electronic equipment



Available in all types, sizes and ranges for all electronic and electrical applications. Send for the Panel Instrument bulletin.

WESTON ELECTRICAL INSTRUMENT CORPORATION, 614 Frelinghuysen Avenue, Newark 5, N. J.


STABILITY in flight
RECORDED ACCURATELY
By Century Model 409
RECORDING
OSCILLOGRAPH
The Century Model 409 Oscillograph was designed for operation under the most adverse conditions, especially where space and weight considerations are limited. It is a miniature, compact unit incorporating many features found in larger models. Records faithfully during accelerations and shock in excess of 20 G's. Its size and capacity make it especially desirable for use in missile launching, parachute seat ejection, flight test of helicopter and fighter aircraft and torpedo studies.
Century GEOPHYSICAL CORPORATION
TULSA, OKLAHOMA

(*Continued from page 18A*)

setups in areas where Electric Switch is not at present represented. Mr. Hoge succeeds William F. Kuehneman as president of these Minerva firms, and the Clark Controller Company contemplates no other changes in the Minerva personnel.

New Organization. A new organization for the development and manufacture of electronic equipment has been formed under the name of Amplitronix, Inc., at 280 Ninth Avenue, New York, N. Y. Products include multi-waveform generators, projection oscilloscopes, electronic timers, and oscilloscope calibrators. Facilities of the organization are available for special development in test equipment or general electronic assembly work.

Bakelite Appointment. C. W. Blount has been appointed vice-president in charge of sales and H. K. Intemann has been named vice-president and general sales manager for Bakelite Company, a division of Union Carbide and Carbon Corporation. Mr. Blount succeeds Mr. Miller who was named president of the company recently; Mr. Intemann succeeds Mr. Blount.

New Corporate Office. Servomechanisms, Inc., designers and producers of electronic and electromechanical controls and instrumentation, recently moved its corporate offices from the company's Westbury Division, Westbury, N. Y., to a new office building located at 500 Franklin Avenue, Garden City, N. Y. The move will facilitate liaison between Servomechanisms, Inc., divisions and also will provide much needed space at the company's Westbury Division.

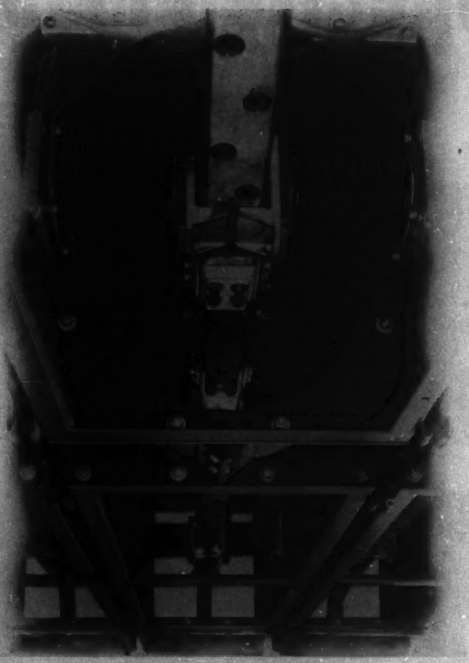
New Canadian Company. The fast growing demand for the Eutectic Welding Alloys Company's low-temperature welding alloys in Canada, has necessitated a special organization to provide adequate service facilities in Ontario and Quebec, Canada. Seven district engineers are now in training at the Eutectic Welding Institute and they will improve the firm's service materially in these heavily industrialized areas. Rene D. Wasserman is president of the Eutectic Company. L. D. Richardson has been named general Canadian sales supervisor, and Michael Doody will supervise the organization in Ontario, Quebec, and the Maritime Provinces.

Atomic Industrial Forum. J. Perry Yates, senior vice-president of Bechtel Corporation, San Francisco, Calif., has been elected a director of the Atomic Industrial Forum, Inc. The Forum was established in April as an association of businessmen, engineers, scientists, educators, and others interested in the nonmilitary development and use of atomic energy. Mr. Yates directs Bechtel Corporation activities in the field of power engineering and construction. The firm, in conjunc-

(*Continued on page 28A*)

ROLLER SMITH ELPECO

METAL-ENCLOSED BUS



is pre-assembled

Ease of installation is one of the outstanding features of all ELPECO bus. Each structure is completely assembled at the factory—then shipped to you in convenient-to-handle, easy-to-install sections.

Because each shipping section is a complete factory assembled unit, including hangers, you are assured of a perfect final installation with a minimum expenditure of time, effort and money.

ELPECO bus structures are available in Non-Segregated Phase, Segregated Phase and Isolated Phase types—for indoor and outdoor uses—designed and constructed to conform to N.E.M.A. standards—furnished in all ratings of 600 volts to 34.5 kilovolts and 600 to 7000 amperes.

For full information write for Catalog 5100.

ELPECO DIVISION
ROLLER-SMITH CORPORATION
BETHLEHEM PENNA.

Specify I-T-E switchgear...

Typical installation of Metal-Clad Switchgear. Shown here at the Tucson Gas & Electric Light & Power Co.

Total cost is the important figure, when comparing makes and types of switchgear. What will the overall cost be, after the switchgear is *installed* and *operating*? Engineering and planning time—as well as installation, maintenance, and operating costs—must all be included in this total.

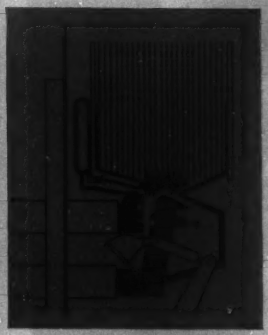
The purchase of I-T-E Metal-Clad Switchgear provides a long series of tangible savings—savings felt during every stage of electrical expansion and new construction.

PLANNING ASSISTANCE

An I-T-E Application Engineer has the experience to help you select coordinated equipment for your specific application problem. This releases your own technical and purchasing staffs for broader planning duties.

for over-all economy

Consider these important benefits from I-T-E Metal-Clad Switchgear:



1

Proved performance and reliability

Superiority of the I-T-E method of arc interruption—*in air*—is thoroughly proved by the thousands of efficient I-T-E power circuit breakers now in service.

2

Quick delivery

Through the years, I-T-E has maintained an enviable record in fulfilling delivery promises. Prompt shipment of switchgear helps to keep construction on time or even ahead of schedule.

3

Simplified testing

I-T-E's unique "fast-test" feature permits secondary circuit testing without opening the circuit breaker compartment door. Racking the horizontal drawout breaker to test position gives safe immediate access to the operating station. Breaker is available for testing in a matter of seconds.

4

Simplified installation

I-T-E switchgear is assembled, tested, and shipped as a complete unit. Floor plan drawings are sent in advance to permit immediate installation of channel base and positioning of conduit or cable. All that remains is to position the switchgear and make necessary connections.

5

Long, trouble-free life

I-T-E selection of premium materials and components pays dividends in long equipment life. Every detail of I-T-E Multumite construction points to continuous, trouble-free service even under the most severe operating conditions.

For details call the I-T-E field office nearest you. Look in the classified section of your telephone directory under "Electrical Equipment". Or write for *Catalog Sec. 7000.* I-T-E Circuit Breaker Co., *19th and Hamilton Sts., Philadelphia 30, Pa.*

I-T-E

METAL-CLAD SWITCHGEAR

1000 MILES AT A GLANCE

You are looking at the Platte Pipeline Company's communications system. 1000 Miles of super-efficient microwave, surveyed, designed, manufactured and installed by *Philco* . . . world's leading manufacturer of microwave equipment.

The entire 1000 miles of this new microwave communications and control system can be seen in a glance at this terminal control board in Kansas City, Missouri. All functions of the pipeline can be observed and controlled at this point . . . The operation of pumps and compressors, the pressures and flow rates of oil, telegraphic printers, VHF mobile and stationery radio, even the operation of the microwave system itself.

Philco microwave provides complete communications and control for this giant pipeline with greater reliability and less maintenance cost than could be obtained from any other type of system

For Complete Information Write to Department EE

PHILCO Trademark for QUALITY at Philco Corp.

PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION

PHILADELPHIA 44, PA.

FERRANTI

. . . a famous name in Electrical Engineering for 70 years

GARRISON DAM PROJECT

N. DAKOTA

Through Ferranti Electric Inc., New York, the Ferranti organisation has secured in open competition the contract to supply the U.S. Army Corps of Engineers with nine single-phase 13.2/230 kV, 33,333 kVA generator transformers, forming three 3-phase 100,000 kVA banks, each bank connected to the 13.8 kV output of one 80,000 kVA hydroelectric generator with a maximum continuous rating of 97,800 kVA.

Products manufactured by Ferranti Ltd. are:

- Power Transformers
- Voltage Regulators
- High Voltage A.C. and D.C. Testing Equipment
- Power Factor Correction Capacitors
- A.C. or D.C. House Service and Switchboard Meters
- A.C. and D.C. Prepayment Meters
- Meter Testing Equipment
- Current and Voltage Transformers
- Electronic Computers
- Electronic Devices
- Valves & Cathode Ray Tubes
- Aircraft Navigational Equipment
- Radar Equipment
- Measuring Instruments
- Summation metering Equipment
- Clip-on Ammeters and Voltammeters
- High Voltage Indicators
- Miniature Hermetically Sealed Transformers and Chokes 'C' Core
- Electric Fires and Space Heaters
- Electric Water Heaters
- Electric Clocks
- Radio and Television
- Synthetic Resin-Bonded Paper Tubes and Cylinders
- Grey Iron, Nomag and NOduMAG Castings

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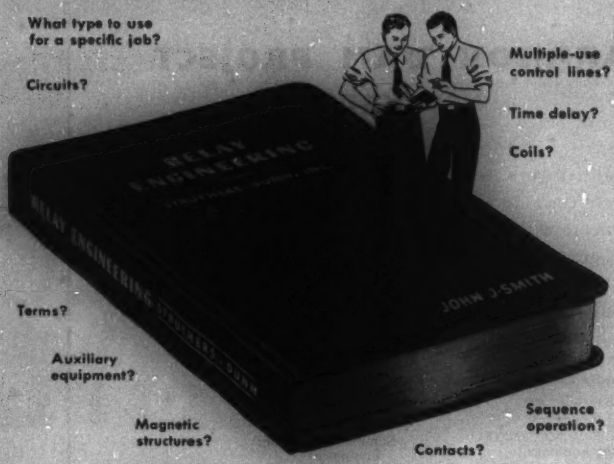
FG138

What's your relay or timer question?



...just look it up in the 640-page
RELAY ENGINEERING HANDBOOK!

Here is relay-timer experience! Over 18,000 copies are now in use helping engineers, designers and others solve relay-timer problems. Replete with more than 1100 diagrams, illustrations and data tables, this pocket-size book is the ideal reference manual for everyone concerned with relay or timer selection, application or service.

Now in 6th printing! PRICE $3.00 per copy

STRUTHERS-DUNN

5,348 RELAY TYPES

S-D

STRUTHERS-DUNN, INC., 150 N. 13th ST., PHILADELPHIA 7, PA.

BALTIMORE • BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI
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(*Continued from page 22A*)

tion with Pacific Gas and Electric Company, is conducting technical studies in the Atomic Energy Commission (AEC) program; and as engineer-constructor has built major AEC facilities. Walker L. Cisler, president of the Detroit Edison Company has been elected president, and Alfred Iddles, president of The Babcock and Wilcox Company, and Dr. Frederick L. Hovde, president of Purdue University, have been chosen vice-presidents. Other directors are John L. Collyer, president, B. F. Goodrich Company, Akron, Ohio; Howard G. Vesper, vice-president of Standard Oil Company of California; Dr. T. Keith Glennan, president, Case Institute of Technology, Cleveland, Ohio; Joseph A. Martino, New York, N. Y., president of National Lead Company; Francis K. McCune, general manager of the Atomic Products Division of General Electric Company; John R. Menke, president of Nuclear Development Associates, White Plains, N. Y.; Dr. Mark E. Putnam, executive vice-president of the Dow Chemical Company, Midland, Mich.; Ross W. Thomas, vice-president of Phillips Petroleum Company, Bartlesville, Okla.; and J. B. Woodward, Jr., president of Newport News Shipbuilding and Dry Dock Company, Newport News, Va.

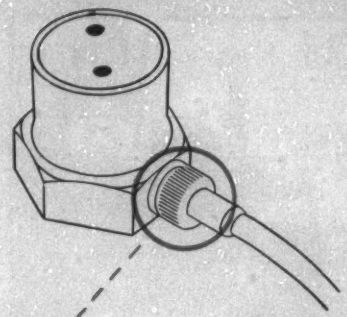
Sylvania Plant. Sylvania Electric Products Inc., has announced plans for a new 416,000-square-foot television-set manufacturing plant to be built in Batavia, N. Y. H. Ward Zimmer, Sylvania president, said that the new plant will be built in anticipation of greatly increased production and sales of television sets. According to John K. McDonough, general manager of the division, division headquarters will remain in Buffalo, N. Y.

Guided Missile Subdivision Established As a result of the rapid growth of development work in guided missiles, the Westinghouse Electric Corporation is expanding the engineering facilities of the Electronics Division in Baltimore, Md. The new engineering subdivision will be known as "Guided Missile Ground Control Engineering." The section will concern itself exclusively with the development, design, and manufacture of models and equipment for guidance of high-speed high-altitude missiles. The new subdivision will be housed eventually in its own building, which will be located adjacent to the company's microwave manufacturing plant. Named to head the new department is Maynard R. Briggs, a veteran of 23 years with Westinghouse, and formally engineering manager of Communication Equipment in Baltimore.

NEW PRODUCTS • •

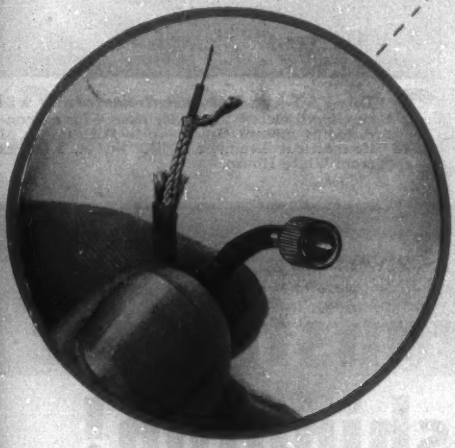
New Insulator. A new insulator to safeguard against one of the less obvious hazards of live-line work has been an-

(*Continued on page 38A*)



Du Pont TEFLON* provides excellent dielectric properties...

...heat resistance and strength in new miniature parts



Coaxial connectors and cable made by Microdot Division, Felts Corporation, S. Pasadena, Calif.

The demand for micro-miniature components in scale with miniaturized circuit designs has created an insulating problem. Miniature circuits often develop high heat and carry an increased electrical load that can result in failure of these tiny components.

The Felts Corporation faced such a problem with its miniature coaxial connector. They needed a material for the connector and primary wire insulation that had good dielectric properties and a wide resistance to heat, chemicals and corrosion. It also had to be moisture-resistant and strong.

After testing many materials, they chose Du Pont "Teflon" tetrafluoroethylene resin. "Teflon" is an excellent insulator. It has a dielectric constant of 2.0 and a loss factor of 0.0005. Its power factor is less than 0.05% even at frequencies as high as 30,000 megacycles. And these dielectric properties are unaffected by temperatures from -80°F. to 500°F. Du Pont "Teflon" is inert to all chemicals except molten alkali metals and fluorine. It is tough and durable—will not crack or arc. "Teflon" has zero water absorption and helps reduce self-generated noise at high termination impedances.

Du Pont "Teflon" serves many uses in electrical equipment—stand-off and feed-thru insulator terminals, insulation for wire, cables and motor windings, and other parts where high temperatures, dielectric strength and durability are required. Perhaps "Teflon" can help you improve or develop a product. For full information, write: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 218T, Du Pont Bldg., Wilmington 98, Delaware.

*REG. U. S. PAT. OFF.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY
Polychemicals
DEPARTMENT
PLASTICS • CHEMICALS

1 **New Network Transformer Installation** provides principal power supply for new office building. Pictures show transformer being moved to site and being installed.

2 **This 750-kva Network Transformer** will supply all electrical service except for air conditioning motors. Location is at junction of Connecticut Avenue and "K" Street, 4 blocks from White House.

A Network Transformer Goes to Washington!

ALLIS-CHALMERS TRANSFORMERS USED ON POTOMAC ELECTRIC'S SYSTEM

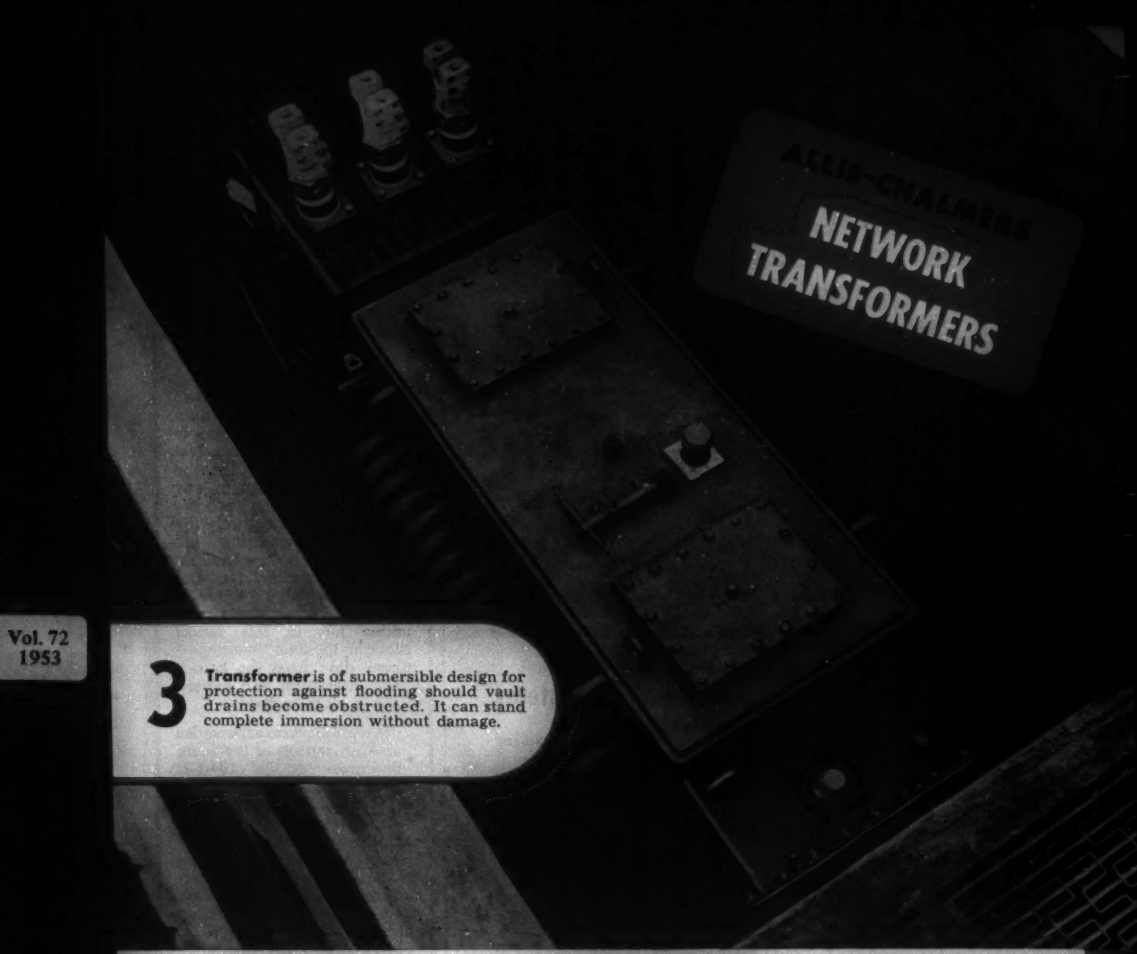
Allis-Chalmers is proud to help serve on the fine network system of the Potomac Electric Power Company. Having had 15 years' experience with Allis-Chalmers network transformers, this utility has found them to give highly efficient performance.

Excellence in construction detail is a major reason why Allis-Chalmers network transformers are chosen by so many utilities. Over 1¼ million kva of these units are now serving the nation's most important systems. Compact, low-loss design and high thermal capacity of Allis-Chalmers network transformers meet the severest load conditions.

See your nearest A-C district office for more details or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4010

ALLIS-CHALMERS



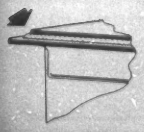
3 **Transformer** is of submersible design for protection against flooding should vault drains become obstructed. It can stand complete immersion without damage.

Here are Reasons Why the System Will Benefit

Spiral Wound Gaskets Are Performance Proved

In over 5 years of continuous use, spiral wound gaskets have proved their superiority over other types of gasket material for sealing bushings in the tank wall.

Alternate plies of preformed spring-like metal and non-metallic fillers provide unusual resilience that actually adjusts itself to changes in operating conditions. This gasket, installed without the use of cements or grease, simplifies the removal of bushings if required. The gasket may be re-used if necessary.



Weld-Seal Construction Eliminates Major Gaskets

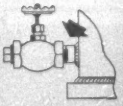
The main cover and switch compartment are welded to the tank to eliminate leaks. Oil sludging and oxidation of insulation is minimized.

Special Surface Treatment Provided

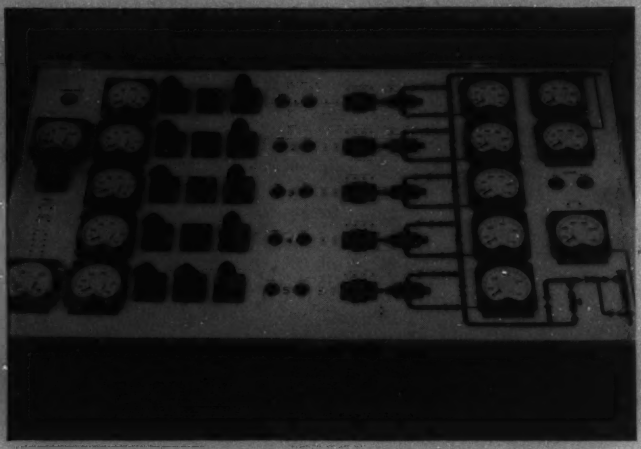
Areas that may be exposed to severe corrosive conditions are thoroughly protected. Tank surfaces are grit-cleaned and given three coats of baked-on phenolic paint (formulated for moisture resistance). A special bituminous compound gives added protection to surfaces and tubes in base areas.

Threaded Valve Connections Are Solder-Wiped

Threaded valve connections are solder-wiped for extra protection. Valves are located for maximum accessibility. Globe type valves with non-rotating seats close tight, avoiding wear on valve seats.



Easy-reading K-24 Instruments



Help you design revolutionary control systems

Alert engineers often bring us new problems in instrumentation. They've hit on a new way to use electrical instruments to improve their operations. We've helped work out many problems like these, and we would like to do this kind of thinking with you.

The photograph above shows what can be done. This desk controls a pipeline booster station. These Westinghouse K-24 instruments are connected to special strain gauges and are calibrated in psi to show *pressures* in the strategic parts of the pipeline system. This revolutionary arrangement eliminated the usual pressure tubing and permitted safer, centralized control of this station.

Notice how much more *readable* these Westinghouse K-24 instruments are than the usual types—from sharp angles and from distances. This is a big factor in modern control board design. And the smaller size and longer scales permit the designer to save space. A single operator can control more processes because he can read the instruments from one place.

Call in Westinghouse when you need instrumentation. And write now for booklet B-4695, "Getting A Full Measure". Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

J-40429

This is the super-readable Westinghouse Full-View K-24 instrument, a triumph of optical engineering. You can read it at sharp angles, and from far away. Glare, shadows and parallax are almost non-existent.

YOU CAN BE SURE...IF IT'S

Westinghouse

EVERYTHING YOU NEED IN METERS AND INSTRUMENTS

Power Supply for Resistance Welding Machines

(April 1952)

AIEE Special Publication S-45 is a report of the AIEE Subcommittee on Power Supply for Resistance Welding Machines. Recognizing that the installation and use of any resistance welding process vitally concerns not only the industrialist requiring the process but also the welding machine manufacturer and the utility supplying the electric power as well, the committee has in this report brought together much pertinent data from the knowledge, literature, and experience in all these fields.

This publication supersedes the AIEE reports of the same title presented in 1940–1. The new work is required by developments in welding machines, new processes, better analysis of certain phenomena (such as measurement of instantaneous loads, and interference between welders), and a clearer understanding of the whole problem of power supply for resistance welders.

This report is not intended to be a complete solution of all welding problems, but should direct attention to the special electrical features involved so that a full analysis developed for a welding project can be readily understood and utilized by manager, master mechanic, and electrical engineer.

◇

Copies are available for the price of $1.00 (no discounts permitted). Address:

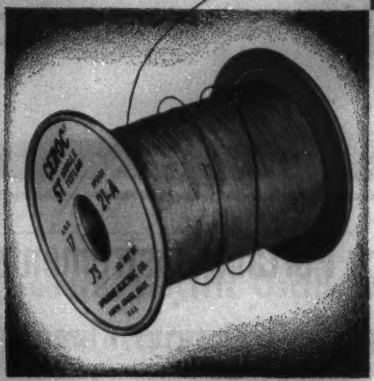
Order Department
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West 39th Street
New York 18, N. Y.

8-53

Ceroc

HIGH TEMPERATURE magnet wires

FOR CLASS H+ OPERATION



If your problem is the design of reliable miniaturized electrical equipment, investigate the size and weight savings possible with Ceroc Magnet Wires.

Ceroc Magnet Wires operate at temperatures well above the 180°C limit for Class H insulation, because they have a base insulation of a thin, flexible ceramic material. No other wire uses this patented construction!

For operation at 250°C, Ceroc ST (Single Teflon) and Ceroc T (Double Teflon) have a tetrafluoroethylene overlay. Both have been used successfully up to 350°C in short-time military applications. Ceroc 200 for 200°C application has a silicone coating on the ceramic to facilitate winding.

Not only does the construction of Ceroc Magnet Wires permit very high current densities, but it also results in better cross-over characteristics in windings than those obtainable with all-plastic insulated wires.

For engineering data on Ceroc Magnet Wires, write on your business letterhead to the Sprague Electric Company, 321 Marshall Street, North Adams, Massachusetts.

Sprague, on request, now will provide you with complete application engineering service and assistance for optimum results in the design and manufacture of components using Ceroc High-Temperature Magnet Wires.

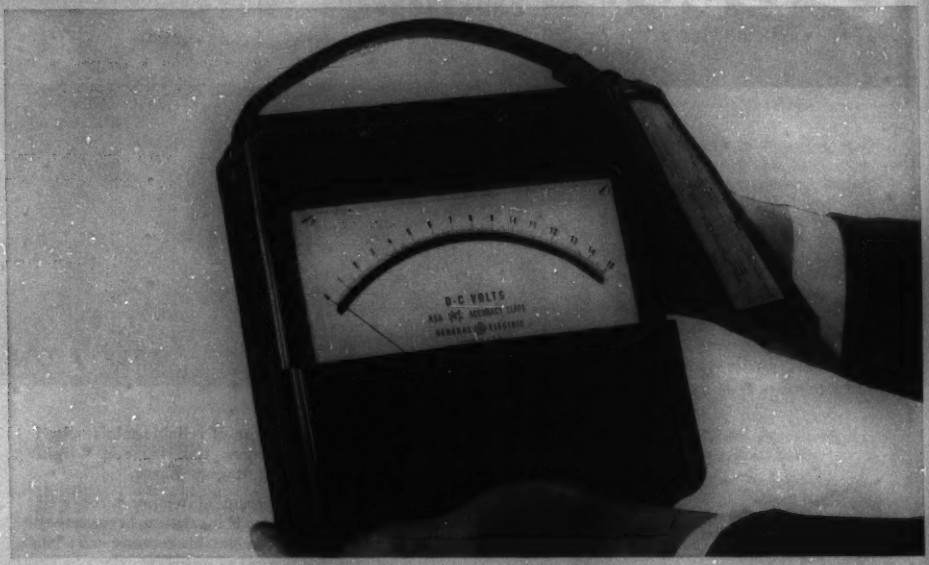
ENLARGED CROSS-SECTIONS OF CEROC MAGNET WIRES

SPRAGUE

PIONEERS IN HIGH TEMPERATURE MAGNET WIRE

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

LABORATORY INSTRUMENTS



NEW LINE OF G-E INSTRUMENTS INCLUDES BOTH ¼% (SHOWN ABOVE) AND ½% ACCURACY CLASS. BOTH FEATURE IMPROVED READABILITY.

G-E Announces New High-accuracy Portable Instruments

ACCURATE READINGS are now assured with long, highly-legible, 5½-inch mirror scale.

Designed for precision work, General Electric's new line of DP-12 portable instruments features accuracy of ¼ of 1% of full scale. Also available for less critical applications is the new line of DP-11 instruments having an accuracy of ½ of 1% of full scale. Both ammeters and voltmeters are available in a wide range of ratings, in both lines.

NEW MOLDED WINDOW

The instrument's new molded window permits illumination of the large open scale from the front and from three sides, and assures maximum scale lighting. The case of these new G-E instruments is made of break-resistant "Textolite."*

SPRING-MOUNTED BEARINGS

The new G-E instruments are equipped with spring-mounted jewel bearings for maximum protection against shock damage.

CONCENTRIC MAGNETIC MECHANISM

The mechanism is of the permanent-magnet, moving-coil type known as "concentric magnet" construction. It assures the utmost in magnetic efficiency.

Priced from $116.00**. Check coupon for free copy of bulletin: GEC-979.

You can put your confidence in—

GENERAL ELECTRIC

FOR PRECISION MEASUREMENT

New G-E Galvanometer Features Easy-to-read, Tilted Scale

With its scale surface tilted 15 degrees from the vertical, the new General Electric galvanometer is now easier to read from any position. Retaining such features as high sensitivity, flexibility, and easily interchangeable elements for different sensitivities, the new galvanometer now provides for a rough zero adjustment without opening the cover.

EASY TO REPLACE LIGHT SOURCE

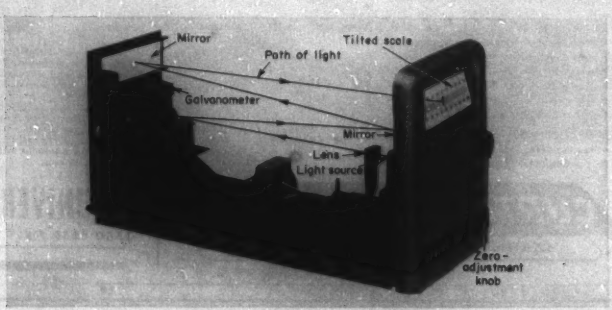
The light source of the new G-E galvanometer can be replaced simply, without danger of injury to the hairline or other internal parts.

NEW METAL CASE

Replacing the wooden case of previous models, an attractive, light metal case with gray hammer-tone finish now is used to enclose the instrument.

Price is $152.00**. Check coupon for bulletin.

ATTRACTIVE NEW CASE conforms to latest trends in laboratory instrument design.



SELF-CONTAINED UNIT, the new G-E galvanometer is a compact and sturdy instrument. No separate lamp stand or scale is required. New tilted scale is easier to read.

General Electric Oscillograph Aids Relay Manufacturer in Developmental Testing

Oscillograms in one minute was the answer recently when a large electrical manufacturer found it necessary to make some rapid development tests on a new type relay. The General Electric PM-18 oscillograph, equipped with a Polaroid-Land film holder enabled the manufacturer to obtain permanent records of each test one minute after test, and to complete an entire series of eight tests in one hour.

ONE-MINUTE OSCILLOGRAMS helped manufacturer make rapid development tests.

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The General Electric PM-18 oscillograph features a variety of highly-sensitive galvanometers and adjustable time sweep of 0.1 to 0.5 seconds.

4 SIMULTANEOUS RECORDS

Designed to record two, three, or four currents or voltages simultaneously, the PM-18 can be used for sine-wave frequencies up to 500 cycles per second with its Polaroid-Land film holder, and up to 2000 cycles per second with the continuous-drive film-holder attachment.

EASILY PORTABLE

Weighing only 30 pounds, the PM-18 can be readily carried to where it is needed. It is not necessary to bring the job to the oscillograph.

LOW COST

The General Electric PM-18 oscillograph, complete with Polaroid-Land film holder and two galvanometers costs only $850.59**. Check coupon for free bulletin.

* Registered trademark, General Electric Co.
** Manufacturer's suggested retail price.

SECTION A605-36, GENERAL ELECTRIC, SCHENECTADY 5, N. Y.

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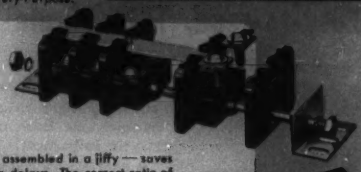
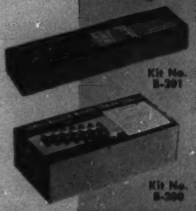


They're assembled in a jiffy — saves ordering delays. The correct ratio of "B" Kits No. 200 and No. 201 permits you to build an assortment of blocks with from 1 to 14 terminals each. The finished block, so built, is identical to the Curtis Type "BT" factory assembled block — unusually rugged — terminal bars have a screw connection at each end — white marker strip and washer-head terminal screws are furnished. Conservatively rated at 30 amperes.

Write for Bulletin DS 118. Other kits are available with capacities of 15 to 75 amperes.



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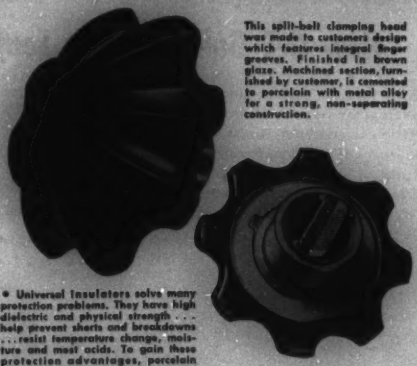

This split-bolt clamping head was made to customers design which features integral finger grooves. Finished in brown glaze. Machined section, furnished by customer, is cemented to porcelain with metal alloy for a strong, non-separating construction.

● Universal insulators solve many protection problems. They have high dielectric and physical strength . . . help prevent shorts and breakdowns . . . resist temperature change, moisture and most acids. To gain these protection advantages, porcelain insulators should be an integral part of your product. A Universal porcelain engineer will be glad to work with you.

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AIEE REPORTS

These publications are proposals for new standards or test codes, or revisions of present publications, which are in the formative stage. They are made available, *without cost*, so that all interested individuals may obtain them for study and comment, thereby supplying practical experience in their use before submission for adoption.

16A Electric Control Apparatus for Land Transportation Vehicles (April 1951)

24 Protector Tubes (July 1940)

28A Valve and Expulsion Type Lightning Arresters (February 1950)

51 Guiding Principles for Dielectric Tests (September 1949)

52 Application Guide for Grounding of Instrument Transformer Secondary Circuits and Cases (March 1951)

502 Test Code for Single-Phase Motors (November 1941)

801 Test Code for Aircraft Interrupting Devices (August 1950)

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TRADE-MARK

"NATIONAL" SA-series brushes were developed especially to provide a higher degree of uniformity in operation than was ever before achieved over a broad field of machines and service conditions. These brushes offer very closely controlled commutation characteristics and permit, with relatively few grades, a highly accurate, efficient brush application technique.

Many years of successful service, on all kinds of equipment and under widely divergent conditions, have *proved* the ability of this brush family to fulfill its objectives. Today, largely because of experience with the SA-series, electrical and maintenance men have come to expect . . . and they *get* . . . much more for their brush dollar all through the mill.

SA-35 . . . has both *good commutating ability* and *long life* for a wide range of motors and generators where heavy loads and high surface speeds are combined with normal commutating conditions.

SA-3538 . . . similar to SA-35 in load-carrying ability and commutation factor, but with distinctly different film-forming characteristics designed to prevent streaking and threading of the commutator under low average-load conditions.

SA-45 . . . unequalled for *ridability at high speeds* and *peak commutating performance;* especially adapted to extremely severe commutating conditions on the most difficult jobs.

It pays to know your "National" brush grades . . . and to look for them under the "National" trademark on every brush you use.

HOW GOOD IS REALLY GOOD BRUSH PERFORMANCE? Write National Carbon Company

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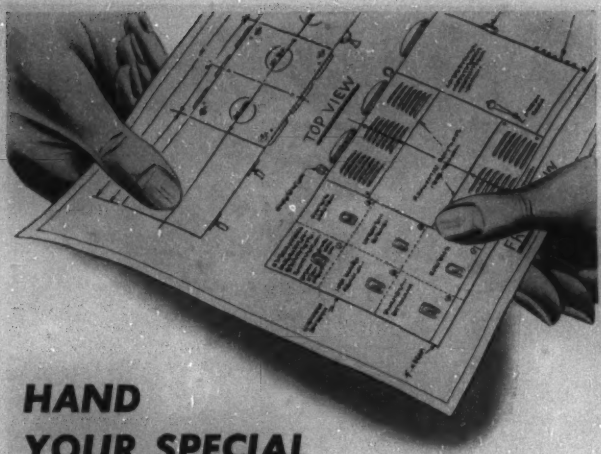

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300 KVA indoor unit sub-station or load center, consisting of high voltage, fused air brake switch and low voltage section with circuit breakers and transformer.

Standard

WARREN, OHIO
REPRESENTATIVES IN PRINCIPAL CITIES

(*Continued from page 28A*)

nounced by Lapp Insulator Company, Inc. Called a bolt-end insulator, this new unit is designed to shield the projecting ends of transformer support bolts, its sole purpose being to protect personnel. When transformer housings are grounded, the through bolts which support them are consequently at ground potential. Such bolts, projecting through cross-arms or poles, constitute a hazard to the lineman who may not recognize them as being grounded. For more complete description, specifications, and prices write Lapp Insulator Company, Inc., Le Roy, N. Y.

Oil Circuit Reclosers. A new expanded line of oil circuit reclosers with a new 1-way seal for moisture protection has been announced by the General Electric Company's Switchgear Department. Units of the new line are available with a time-current characteristic that allows interchangeability with other makes. The 1-way seal, placed around the operating handle shaft of the units, permits the release of internal pressure, but prevents moisture-laden air from entering the recloser since all other possible openings are fully gasketed. With moisture problems eliminated by the new seal, maintenance may be reduced to that required because of oil carbonization and contact burning. Current ratings added in the new line, Type *FR*, are 70, 100, and 140 amperes. The entire line includes single- and 3-phase units with 5 to 140 amperes current rating, 2,400 to 14,400 volts, and 125 to 2,500 amperes interrupting capacity. The new line of reclosers retains the time-current characteristic obtained by a positive mechanical timer.

Two Transistor Types. Two transistors, Types *WX-3347* and *WX-4813*, for developmental use in amplifier, oscillator, and switching circuits, are available in sample lots from the Westinghouse Electronic Tube Division. Both types are provided with leads for wired-in installation. The *WX-3347* is a point-contact-type transistor. Typical operating characteristics when used as a grounded-base amplifier under small signal conditions are: collector current, 2 to 3 milliamperes; power gain, 18 decibels; cutoff frequency, 2 megacycles. The *WX-4813* is a positive-negative-positive junction-type transistor. When used as an amplifier with grounded emitter and base input, typical operating characteristics are: collector current, 1 to 2 milliamperes; power gain, 30 decibels. For further information, write Westinghouse Electronic Tube Division, Department T-194, Box 284, Elmira, N. Y.

Wire-Wound Resistor. A new resistor developed by the Shallcross Manufacturing Company, Collingdale, Pa., measures only 1/16 inch long by 17/64 inch in diameter. Designed to save space in subminiature industrial and military equipment, the new precision wire-wound resistor can be mounted either by its radial wire leads or by an axial number 2 clearance hole through the resistor's steatite

(*Continued on page 50A*)

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For more than thirty years TIREX Cords and Cables have been steadily improved. Today, they combine the famous *cured-in-lead* process with an extra-tough selenium-neoprene armor that can withstand even the toughest assignments.

Remember when you buy cords and cables, if it isn't Simplex, it isn't TIREX.

More complete information may be obtained from your nearest Simplex distributor or by writing to the address below . . .

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American Standard
LETTER SYMBOLS
for
ELECTRICAL QUANTITIES

This American Standard (Z10.5—June 1949), which has been prepared by a subcommittee of the Sectional Committee on Letter Symbols and Abbreviations for Science and Engineering, is a revision of ASA Z10g1 and AIEE 17g1.

General principles of letter symbol standardization, a typographical notation for distinguishing, in the equations of the printed page, between the symbols for scalar, complex (phasor), and vector quantities are given, as well as tabulations of the symbols in alphabetical order of the names of quantities, English letter symbols, and Greek letter symbols.

Price: $0.60; there is a 50 per cent discount for AIEE members.

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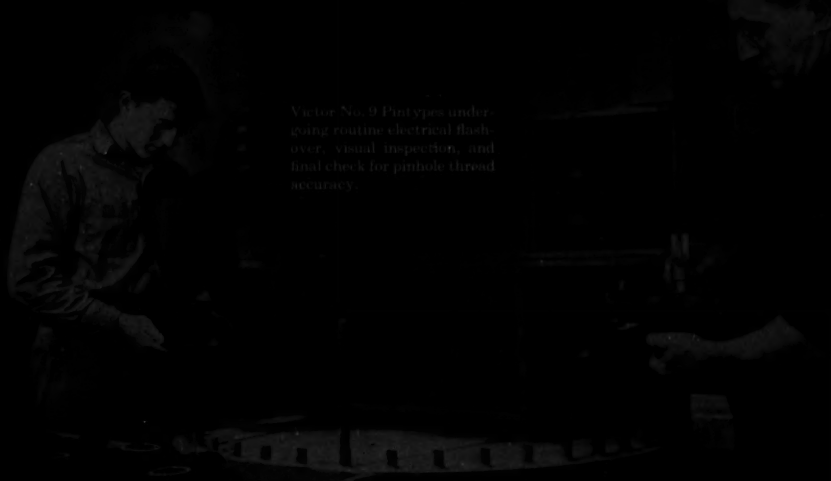
Vol. 72
1953



Victor No. 9 Pintypes undergoing routine electrical flash-over, visual inspection, and final check for pinhole thread accuracy.

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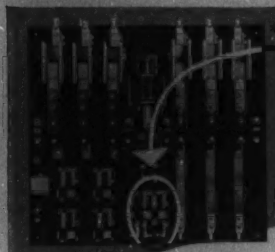

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Momentary Outages
Essential for More and More Installations

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We'll be glad to send details of this Time Delay feature; also the story of ASCO Service to Industry on this particular phase of Electromagnetic Controls which is given in a new booklet, "Automatic Transfer Switches", now on the press.

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In answer to another synchronous converter problem, National engineers proposed substantial voltage reductions which resulted in a 26% increase in the capacity of the National-rebuilt sets.

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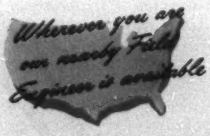
If you have a problem with any piece of rotating electrical equipment, it will pay you to consult National.



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LIGHTNING REFERENCE BIBLIOGRAPHY 1936-1949

Prepared by the AIEE Lightning and Insulator Subcommittee, this bibliography, S-37, contains 754 separate references on lightning and related topics published from January 1, 1936, to December 31, 1949, in most of the better known English, French, and German journals on electrical engineering or physics.

For easy reference, there is a Subject Section, subdivided into 18 classifications, and an Author Section, which contains a list of about 550 authors. Price: $0.70 ($0.35 to AIEE members).

Available from the Order Department, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 33 West 39th Street, New York, N. Y.

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MINIMIZATION of INTERFERENCE from RADIO-FREQUENCY HEATING EQUIPMENT #951

This report on a recommended practice reviews the theoretical aspects of the interference problem and then outlines procedures which should be followed; which may be applied both in construction and as remedial measures where interference exceeds limits specified in FCC rules. Price $.80; 50 per cent discount to AIEE members. Address:

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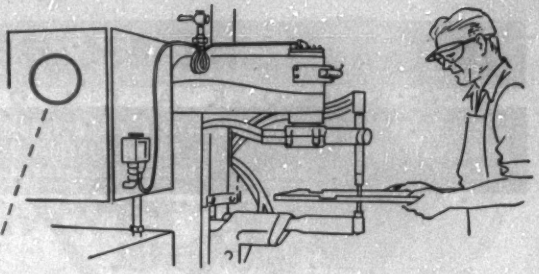
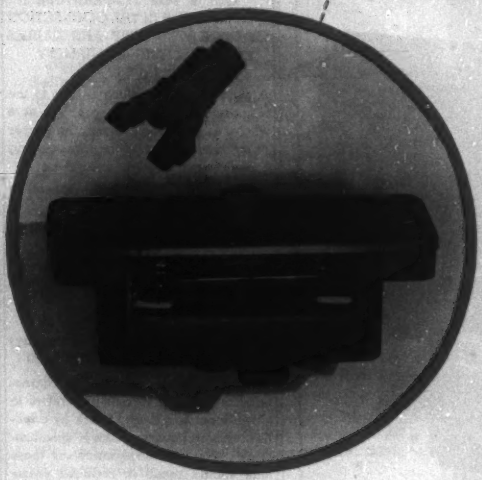


Improved switch performance with Du Pont nylon plastic



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for
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Molded part increases electrical clearance and service life of snap switch . . . cuts costs

Precision snap switches are used as limit controls in small machine tools and as basic contact mechanisms in industrial instruments. In timing relays on resistance welding machines, for example, they control the duration of current flow and electrode motion. Two key parts affecting the switch's performance are the operating button and stem. They require accurate dimensions that must stand up under severe wear.

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This is another example of where Du Pont nylon plastic serves industry as a superior engineering material. Perhaps it can be of value to you. For full information on nylon and other Du Pont plastics, write: E. I. du Pont de Nemours & Co., (Inc.), Polychemicals Department, Room 218, Du Pont Bldg., Wilmington 98, Delaware.

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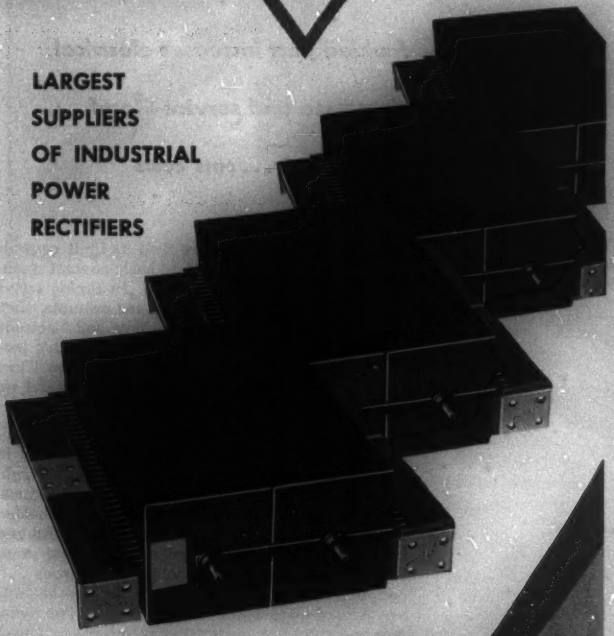

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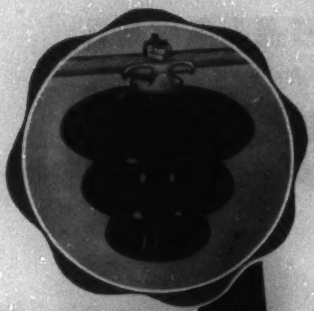


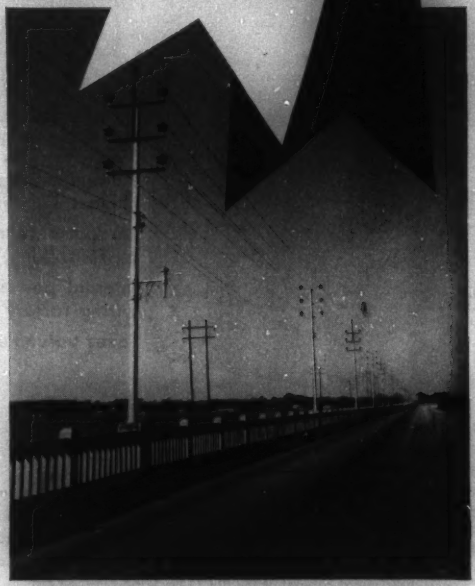
on the basis of plain merit!

Even the best tie wire won't stay tight indefinitely. Unbalanced spans, wind, ice loading; all tend to deterioriate a tie connection. Then comes conductor movement, chafing over the hard insulator head, strand damage, and even possible parting of the cable. Loose ties are also a common source of radio interference.

With the O-B Clamptop on your favorite insulator, either pintype or post, a permanent conductor attachment is certain. Stronger than the tightest newly-applied tie, it never relaxes its hold.

Along with this definite operating advantage goes extreme ease of installation. An inexperienced man with a common hand wrench can get a perfect job on every insulator in half the time it takes to make the simplest tie. Clamptops are a "natural" for hot-stick working.

Try the O-B Clamptop and see for yourself why it is replacing the tie wire--on the basis of plain merit!



Bordering open waters of the Gulf, this line is exposed to the full force of hurricanes. Clamptop insulators have contributed to a record of no windstorm outages.

Loosened tie wire, caused by unbalanced span, permitted conductor movement that "sawed" ¼-inch into the porcelain head of this insulator before cable failure occurred.

Ohio Brass

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IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

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- Internal power and control wiring factory installed.
- Saves valuable floor space.

They're self-contained, *packaged units*, offering a perfect balance of safety, efficiency and durability. Starting contactor, voltage and current controls, transformer, filter components, rectifiers, meters and protective devices—all components necessary for rectifier operation and control are contained in the heavy sheet metal cabinet of the PECO Packaged Equipment . . . Compact design eliminates the necessity of installing separate starter and control panel and the interconnection of power and control circuits . . . AC input and DC output leads may be brought in from the top, simplifying conduit installation . . . There are no moving parts . . . No fans or other ventilating equipment required . . . No special foundations necessary.

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☆ Battery Chargers ☆ Battery Eliminators ☆ D.C. Power Supply Units ☆ Regulated Rectifiers ☆ and other Special Communications Equipment

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JOINT AIEE-IRE CONFERENCE ON TELEMETERING AND REMOTE CONTROL

AIEE Special Publication S-54 contains papers and discussions presented at the Conference on Telemetering and Remote Control sponsored by the AIEE and the Institute of Radio Engineers (IRE) and held at the Lafayette Hotel, Long Beach, Calif., August 26–27, 1952.

Four sessions were held during the two days and 17 papers were presented. Subjects covered include both wire and radio telemetering. The first session dealt with papers on telemetering pickups. A paper on "Theory and Design of Vibrating Wire Transducers" describes a relatively new type of telemetering pickup with good stability and high-frequency response.

At the second session, three papers dealing with problems of FM-FM telemetering systems were presented. The session was concluded with a panel discussion on problems of radio telemetering. A brisk discussion from the floor resulted from the panel presentations and is included.

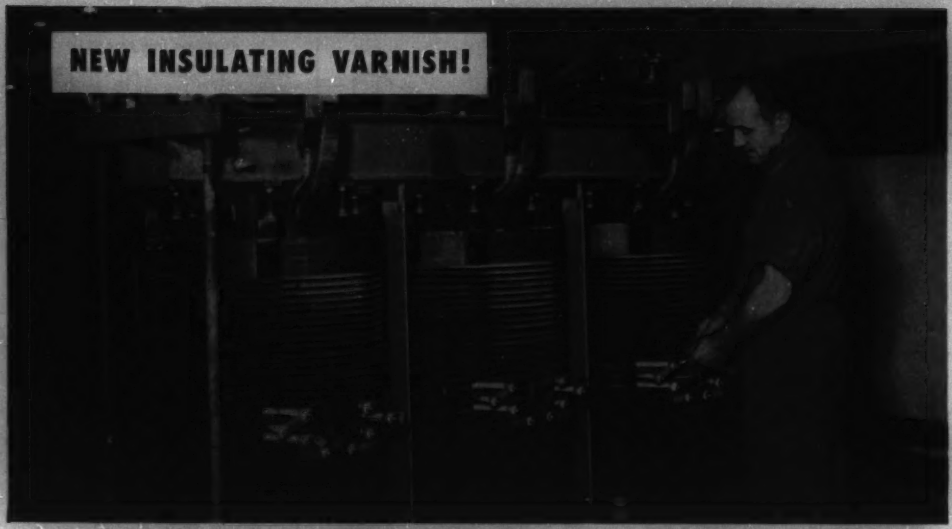
The third session continued the discussion of radio telemetering problems. A paper at this session described some of the problems encountered in telemetering data required for upper atmosphere research.

The final session dealt with wire telemetering. Problems of power systems, telephone systems, and petroleum production operations were discussed in four papers.

Publication S-54 is available at the price of $3.50 to members and nonmembers from:

Order Department
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West 39th Street
New York 18, N. Y.

8-53



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Here's a new, all-round silicone insulating varnish for Class H insulation! General Electric's SR-17 combines heat resistance, low-temperature flexibility and bonding strength in *one* silicone resin. Specify it for excellent electrical and physical properties in coating, bonding or impregnating applications such as:

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% Moisture absorption, 96 hrs	0.05

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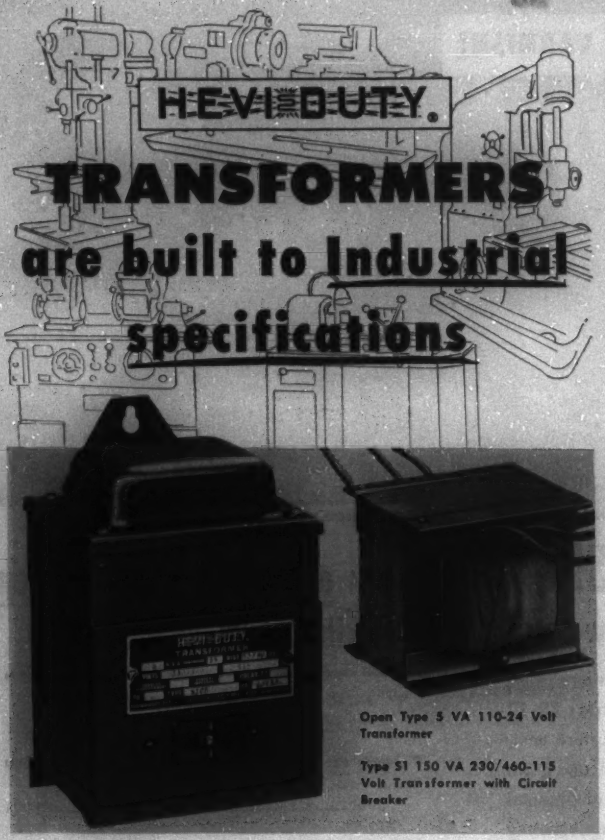

Open Type 5 VA 110-24 Volt Transformer

Type S1 150 VA 230/460-115 Volt Transformer with Circuit Breaker

You can now buy small specialty transformers for industrial control built to the same high standards that have chacterized larger HEVI DUTY transformers for many years. They are . . .

★ Designed for HEVI DUTY service.

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★ Completely tested for HEVI DUTY applications.

Sizes 5 VA and larger are available
Write for complete details

HEVI DUTY ELECTRIC COMPANY

MILWAUKEE 1, WISCONSIN

Heat Treating Furnaces . . . Electric Exclusively
Dry Type Transformers *Constant Current Regulators*

(*Continued from page 38A*)

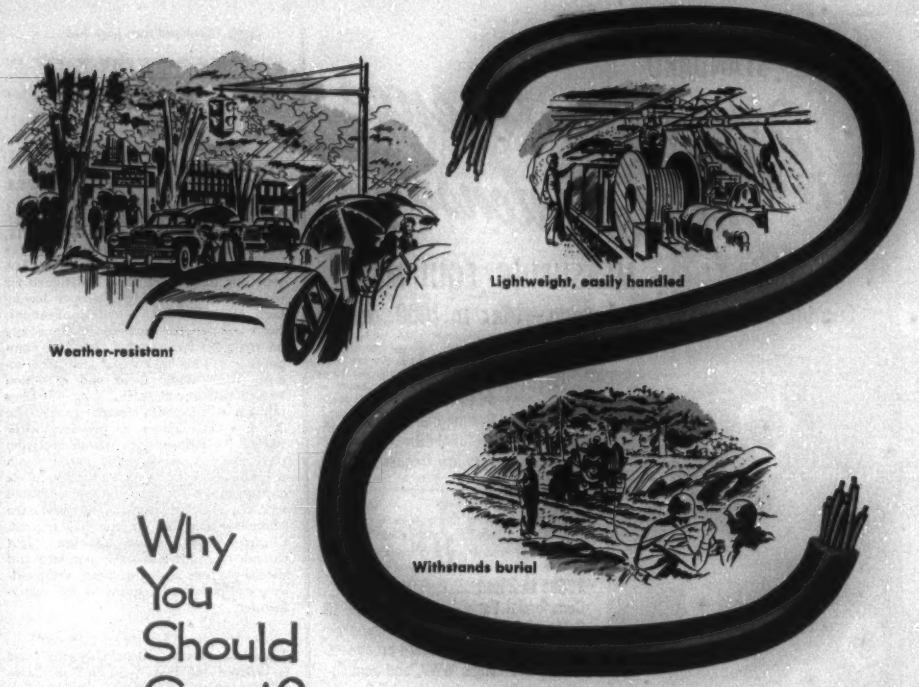
bobbin. Designated as Type *16*, the tiny 0.1-watt resistor can be noninductively wound in all values up to a maximum of 150,000 ohms. Standard tolerance is 1 per cent with closer tolerances available. When processed with Shallcross *BX* impregnation, the Type *16* resistor will withstand prolonged exposure to high humidity. For less severe applications, lacquer coating is available. A sales drawing of the Type *16* resistor is available on letterhead request to the manufacturer.

Varistors. A new line of varistors, nonlinear resistors, has been introduced by the International Resistance Company's Special Products Division in the Philadelphia, Pa., plant. These units have many applications in circuits where sharp variation of resistance with applied voltage is required, and are available in five convenient cell sizes in a wide variety of enclosures. For further information on new IRC varistors, write International Resistance Company, 401 North Broad Street, Philadelphia 8, Pa., for catalogue, Data Bulletin *SR-3*.

Selenium Rectifiers. International Rectifier Corporation has developed a complete line of selenium rectifiers for use in radio, television, television boosters, and ultra-high-frequency converters. The units are rated for 130 volts rms maximum input for load currents of 20, 30, 40, 50, 65, 75, 100, 150, 200, 250, 300, 450, and 1,000 milliamperes. One of the rectifiers, Type *RS75E*, is rated as follows: maximum input, 130 volts rms; maximum peak inverse, 380 volts; maximum output current, 75 milliamperes. A series resistor of at least 22 ohms is recommended as a current limiter when used with a capacitive filter. The over-all dimensions of this rectifier are 1 inch wide by $1\frac{1}{4}$ inch high by 3/4 inch deep and it is provided with a clearance hole for a number *8* machine screw for mounting.

Distribution-Transformer Connectors. New connectors that will allow utilities to connect either aluminum or copper conductors to distribution transformers, in spite of the different characteristics of the two metals, have been announced by the General Electric Company's Distribution Transformer Department. The changes in connector design were made because many utilities are now using aluminum conductors. To be furnished with all General Electric pole-type distribution transformers, the new high-voltage tank-wall bushing connector features a stainless-steel follow-up spring. Built with an extra large serrated bearing surface, which securely grips the wire and breaks down the aluminum oxide, the spring maintains a tight connection even when cold-flow occurs. In test, with the bushing connector relaxed to simulate a 10-per-cent creep in number *6* aluminum wire, the new connector holds the wire without any movement under 200 pounds

(*Continued on page 52A*)



Why You Should Specify...

CABLE JACKETED WITH VINYLITE BRAND PLASTIC OVER BAKELITE TRADE-MARK POLYETHELENE CORES

This combination of wire and cable covering materials brings you a collection of properties that meet the most severe operating conditions.

Outer jacketing of VINYLITE Brand Plastic is resistant to abrasion, weathering, corrosive atmospheres, brine, most acids and alkalies, oil and grease. It has withstood seven years' immersion in water and twelve years' burial in the ground without failure. Specially formulated compounds stay flexible and impact-resistant down to —67 deg. F.

BAKELITE Polyethylene has excellent electrical properties wet or dry—a dielectric constant of only 2.3, a power factor of only 0.0004 at 50 megacycles and 25 deg. C. It provides smaller diameters, faster stripping and splicing. Its extremely light weight—specific gravity only 0.92—means easier handling. It endures wide temperature extremes—stays flexible down to —70 deg. C., resists deformation up to 90 deg. C. It withstands water, aging, most chemicals, abrasion.

Speeding installation, giving long, trouble-free service life, suited to a wide variety of operating conditions, these materials are unsurpassed as wire and cable covering. Whether your requirements are for military or civilian applications, jacketing of VINYLITE Brand Plastics over BAKELITE Polyethylene cores will pay off in performance. For a list of suppliers, write Dept. RK-66.

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STANDARD

Radio Interference and Field Intensity

MEASURING EQUIPMENT

Complete Frequency Coverage—14kc to 1000 mc!

NM-10A

VLF

14kc to 250kc

Commercial Equivalent of AN/URM-6B.

Very low frequencies.

NM-20B

HF

150kc to 25mc

Commercial Equivalent of AN/PRM-1A. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies. Has B.F.O.

NMA-5A

VHF

15mc to 400mc

Commercial Equivalent of TS-587/U.

Frequency range includes FM and TV Bands.

NM-50A

UHF

375mc to 1000mc

Commercial Equivalent of AN/URM-17.

Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as MIL-I-6181, MIL-I-16910, PRO-MIL-STD-225, ASA C63.2, 16E4, AN-I-24a, AN-I-42, AN-I-27a, MIL-I-6722 and others.

STODDART AIRCRAFT RADIO Co., Inc.

6644-B Santa Monica Boulevard, Hollywood 38, California

(*Continued from page 50A*)

pull. The company plans to make the new connectors standard within a few months on all its pole-type distribution transformers.

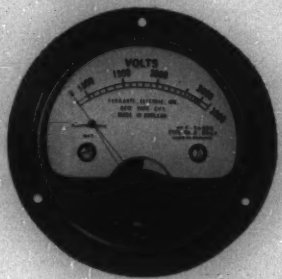
Cathode-Ray Tube. Larger display, higher sensitivity, and closer tolerances are the features of the new Type *72RA*, 2-gun cathode-ray tube just announced by the Electronic Tube Corporation, 1200 East Mermaid Lane, Philadelphia 18, Pa. Similar in many respects to the company's widely used *5S* tube of RTMA type, the new 7-inch tube is designed for use in dual-channel oscilloscopes having high sensitivity. In such applications, two traces may be presented simultaneously on the tube face for fast, accurate comparative studies of independent phenomena. Electrostatic focus and deflection as well as adequate shielding against cross talk are used for both electron guns. The *72RA* tube employs a post-accelerator intensifying electrode and has all deflection plate connections brought out through the tube neck to minimize interelectrode capacitance. The tube normally is coated with *P1* phosphor, but all other standard phosphors can be supplied on request. Complete specifications on the *72RA* cathode-ray tube and other standard and special-purpose multigun tubes are available on letterhead request to the manufacturer.

Transistor Device. Development of what is believed the first "grid-dip" oscillator using a transistor and covering the five major amateur radio bands has been reported by the Tube Department of the RCA Victor Division, Radio Corporation of America. The experimental electronic test instrument is built around a single *RCA-2N33* point-contact transistor and is powered by a miniature $22\frac{1}{2}$-volt hearing-aid battery. This transistorized device is compact, lightweight, and portable, and is used to determine the resonant frequencies or wavelengths of tuned circuits. The instrument's power consumption is only 25 milliwatts.

Waveguide Attenuator. A new kind of waveguide attenuator that gives direct and precise readings from 0 to 50 decibels has been developed by the Hewlett-Packard Company. The instrument, Model *X382A*, provides highly accurate decibel readings that are completely independent of frequency. Phase shift is independent of attenuation setting and accuracy is either ±2 per cent of decibel reading. The attenuator is directly set and read and requires no interpolation or charts. Design of the compact instrument is unique in that the attenuation depends on the angular position of the attenuating film rather than its specific resistivity. Model *X382A* employs three resistive films, two mounted in line within each waveguide extension, and a third film rotatable axially in the center section. With all three films aligned in the same plane, there is no attenuation. Rotating

(*Continued on page 58A*)

A TRUE ELECTROSTATIC VOLTMETER



This instrument permits voltage readings on AC or DC circuits of very high resistance. The only current drawn is the very small leakage current and a very low capacitance current on AC circuits. Very useful for the many high voltage—low current circuits employed in nuclear research. Available with full scale voltages ranging between 300 and 3500 volts. Special laboratory instrument available with full scale reading of 150 volts. Full scale capacitance ranges from 8 mmfds for the 3500 volt model to 100 mmfds for the 150 volt instrument. Magnetic damping. 2½" dial. Write for complete specifications.

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Quality FAST Capacitors

That Which Follows

Getting to the bottom of things

The impregnation of capacitors is a very critical operation. This operation is divided into two phases. The first phase is to dry and degas the assembled unit. The second phase is to saturate the winding completely and fill the container with the impregnating liquid. The better the job of impregnation, the higher the quality of the capacitor.

John E. Fast & Co. assures the superior quality of its capacitors because of the uniformly high standards which must be met at each stage of operation. After the units are placed in tanks and the tanks sealed, the heating cycle is started. The next step is to evacuate the tanks. This cycle continues until there is a vacuum of 100 microns or lower. (Our usual is 50 microns.) This completes the first phase of the operation.

While the vacuum cycle is progressing, the liquid (Aroclor) is being filtered and treated. We have an electronic device which controls this filtering process and records the continuous test results. The liquid must meet the specified requirements of dielectric constant, power factor, and purity before this device opens the valve to allow the liquid to enter the tank.

Capillary action draws the impregnant to the center of the windings, therefore eliminating any chance of dry spots. After the windings are completely saturated, pressure is used to force the liquid into every corner and crevice of the unit. Next comes another temperature cycle, during which the units are maintained at the proper sealing temperature for a period of hours, after which they are quickly sealed.

It must be apparent, from the process-outline above, that the quality of a capacitor can be no better than the precise control maintained in the impregnation cycle . . . irrespective of the excellence of materials used in the assembly.

The FAST organization rigidly adheres to the highest standards from basic materials to processing, through life-testing to the finished product, as was covered in the three earlier items in the series "Getting to the Bottom of Things"—thus substantiating our claim to being *Capacitor Specialists*.

JOHN E. FAST & CO.
Capacitor Specialists For Over A Third of A Century
3169 North Pulaski Road, Chicago 41, Ill.
"WHEN YOU THINK OF CAPACITORS . . . THINK FAST"

AVAILABLE LITERATURE:
Polystyrene Capacitors in paper tubes or metallic containers: SEC. IV, CATALOG 25.
Jan C-25 Approved Capacitors: Refer to Jan C-25, "Specifications"
Power-Factor Correction Capacitors: SECS. I, II, III, IV, CATALOG 27

Quality FAST Capacitors

New Westinghouse relay coordinates with adjacent induction relays

Now, relays on sub-transmission lines and distribution feeders can be more effectively coordinated by using the new, high-speed HRZ relay. This Westinghouse development contains, in one case, an instantaneous impedance element, an overcurrent element and a directional element, plus auxiliaries.

Effective Coordination—This relay provides back-up protection which can be more effectively coordinated with inverse overcurrent relays installed on adjacent line sections. The time-current curve of the back-up element of the HRZ relay is very similar to the characteristic curve of the adjacent overcurrent relays, thus permitting selective operation of relays for sectionalizing transmission lines.

High Speed—The HRZ relay also provides instantaneous phase fault protection for 80 to 90% of the line section it covers. It may be economically applied where more expensive equipment cannot be justified. The HRZ relay, therefore, gives high-speed protection, plus coordinated back-up protection, on installations which do not require more than one back-up element.

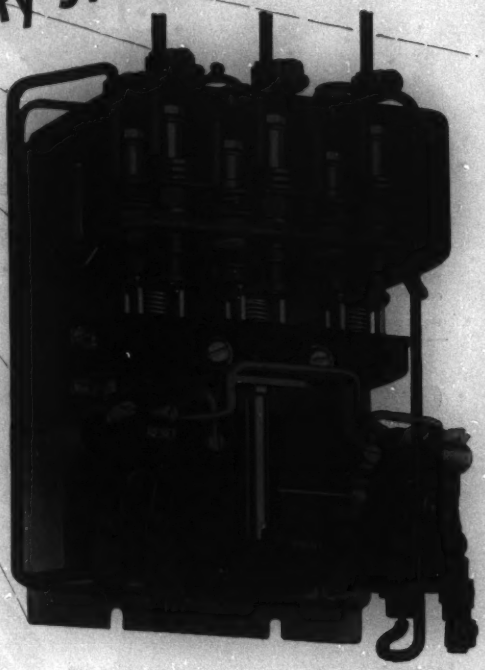
Out of the Westinghouse Relay Laboratory in Newark, N. J., has come, through the years, a constant parade of relay "firsts". For the finest relay engineering, the very latest relay developments, look to Westinghouse.

For more information on the HRZ relay, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-40457

YOU CAN BE SURE... IF IT'S Westinghouse

KEEP YOUR EYE

On this Heavy Duty Starter



Phantom view showing complete power circuit

The new CLARK Size 3, Type "CY" Starter, is built for heavy duty operation.

Pioneered and proved in the Size 2, Type "CY", the same principle is now offered to the Size 3.

The design embodies an entirely new concept.

For the first time in electrical control history, strong multi-turn magnetic blow-outs are combined with twin-break controls, in economical space.

Enclosing each arc chamber is a steel case which carries the flux, and is tops in non-carbonizing.

By applying the effect of the blow-out coil concentric with the contact, the arc is quenched.

The most important action is the constant forced rotation of the arc.

This forced rotation prevents the arc from striking repeatedly on the same spot.

This results in minimum contact wear and longer contact life.

Accumulation of ionized gases between the wiring terminals is prevented because the top of the arc chamber is closed.

Thousands of CLARK Type "CY" STARTERS are giving satisfactory operation in all types of industry.

By using CLARK Type "CY" STARTERS your control problems can be simplified.

***You'd Better Try* CLARK *type* "CY"!**

THE CLARK CONTROLLER CO.

ENGINEERED ELECTRICAL CONTROL • 1146 EAST 152ND STREET, CLEVELAND 10, OHIO

1 CONDUIT DOES THE WORK OF 2

WITH ROCKBESTOS PNR CONTROL CABLE

Because Rockbestos PNR is approximately ½ the size of competitive control cable, you pull 12 conductor PNR in one conduit where before you had to use two conduits or double diameter conduit to carry the same amount of cable.

Result — one conduit carries almost twice its former electrical load. You save steel conduit and fittings . . . and cut installation costs.

Get the complete PNR story, today. Write or ask your nearest Rockbestos representative.

QUICK FACTS ABOUT PNR

46% smaller area*... 28% smaller diameters*. Use smaller conduit and fittings or put more conductors in present conduit.

Dielectric breakdown . . . over 40 times operating voltage.

Lighter and smaller. Easier to handle, store, ship, pull through conduit.

Flexible to — 25 C (—13 F). No cracking!

Rated 600 volts . . . conductor operating temperature 75 C (168 F).

*Average determined by comparison with competitive control cable.

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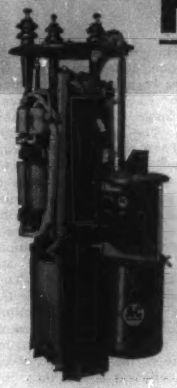
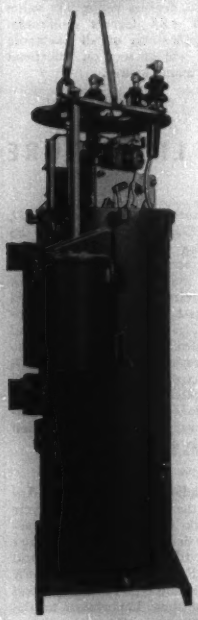


Look at Design. Real proof of quality comes only from a point-by-point comparison when you look inside a voltage regulator. Inside an Allis-Chalmers distribution regulator you'll find the reasons why you get ± 1 volt accuracy and 20% range of regulation over years and years of relatively trouble-free operation.



Look at Workmanship. Unit construction — an exclusive feature of A-C 5/8% step voltage regulators — is the reason why you get highest quality workmanship. Transformer, mechanism, control, cover and bushings are built as an integral unit. As a result, *all* connections can be made before tanking. And inspection can be accurate and thorough — thanks to such easy accessibility.

Then...Look at the Record. Only from Allis-Chalmers do you get field experience that proves accuracy and reliability. A-C distribution regulators have been turning in profitable field records since 1944 — and they are based on a total of 20 years of 5/8% step regulator experience. It will pay you to get all the facts. Call the A-C district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

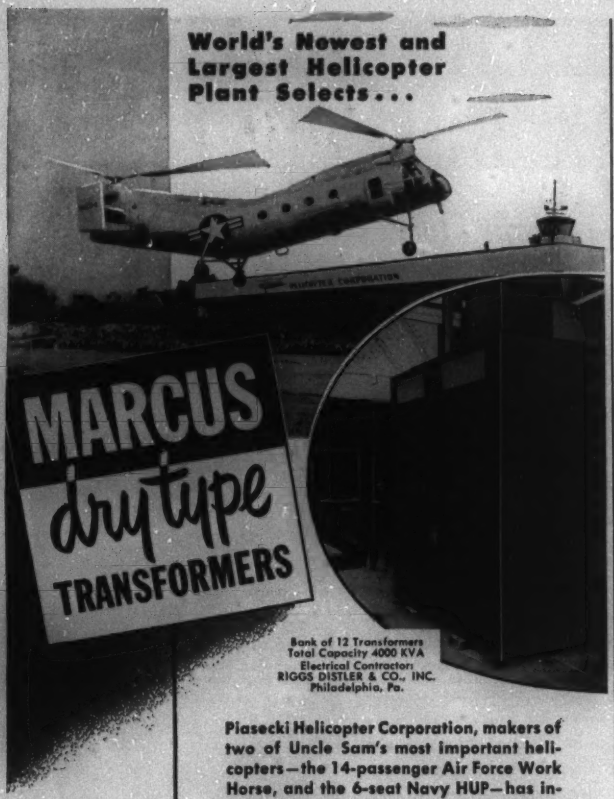
A-4104

RATINGS AVAILABLE	7620 Volts—15, 50, 100 amp 5000 Volts—50, 100 amp 2500 Volts—100, 200 amp

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Originators of 5/8% Step Regulation



Piasecki Helicopter Corporation, makers of two of Uncle Sam's most important helicopters—the 14-passenger Air Force Work Horse, and the 6-seat Navy HUP—has installed Marcus dry type Transformers to do the vital power job in their big new plant at Morton, Pa.

They were selected because every detail of the Marcus dry type transformer is engineered for long life... and continuous, trouble-free performance. Latest contribution pioneered by Marcus for greater transformer durability is Hi-Heat, Hi-Dielectric Magnet Wire, insulated with DuPont's newest miracle polyester film "*Mylar*," combined with Johns-Manville "*Quinterra*" to reach insulation levels at least 10 times present industry standards.

Capacities from 1 to 3000 KVA

- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
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MTC

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MARCUS
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HILLSIDE 5, NEW JERSEY

Representatives in Principal Cities

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DRY TYPE TRANSFORMERS EXCLUSIVELY

(*Continued from page 52A*)

the center film with the front panel knob increases attenuation proportionally to the cosine squared of the angle of rotation. Model *X382A* is now offered only for X-band use at frequencies from 8,200 to 12,400 megacycles. Calibrated range is 1 to 50 decibels, voltage standing wave ratio is less than 1.15 throughout range, and zero setting attenuation is less than 1 decibel. Power may be fed to either end.

Capacitors. Thirty-nine new values in fixed composition capacitors, Type *GA* capacitors, have been added to the types made by the Electronic Components Division, Stackpole Carbon Company, St. Marys, Pa. The complete range now includes 46 RTMA preferred values from 0.10 magnetomotive force to 10.0 magnetomotive forces, in standard tolerances of 5, 10, and 20 per cent. The many new values are designed to meet the growing need for inexpensive low-value fixed-composition capacitors for communications and ultrahigh-frequency television applications. Rated for a working voltage of 500 volts direct current, Stackpole *GA* capacitors are molded from titanium dioxide or other high-dielectric-constant body material to provide insulation resistance in excess of 1,000 megohms. Temperature coefficient is less than ±2 per cent of 20 degrees centigrade value from −55 to +85 degrees centigrade. Complete specifications of all Stackpole *GA* capacitors will be sent on letterhead request to the manufacturer.

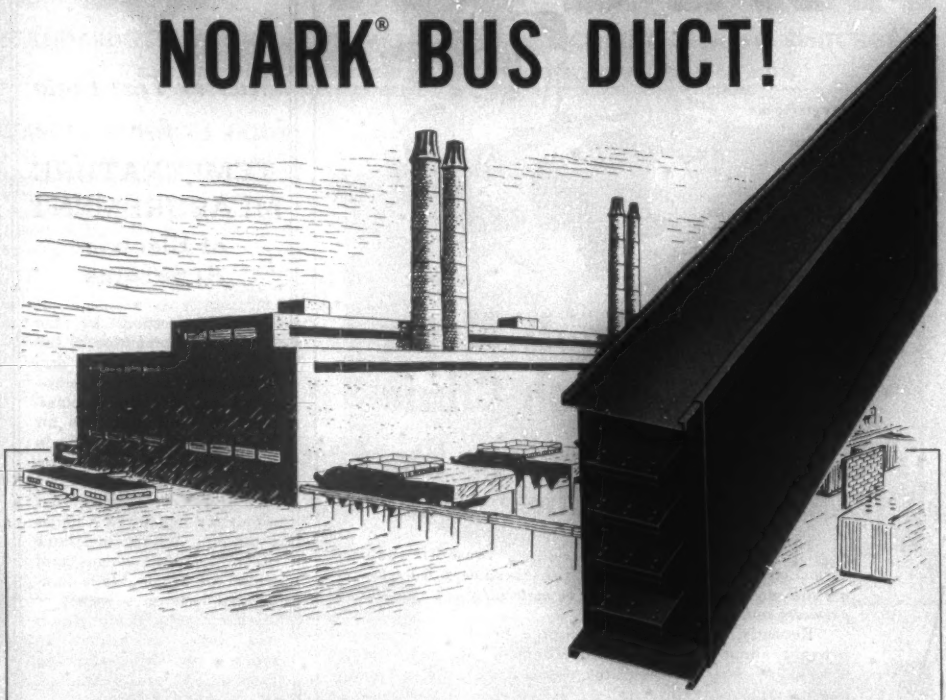
TRADE LITERATURE

ElectroniK Controllers. Catalogue *1530*, "ElectroniK Controllers," contains 56 pages describing all types of ElectroniK control instruments which are used to measure and control a multiplicity of process variables. Included are detailed specification and control action descriptions and ratings for both electric and pneumatic controllers. The literature also presents engineering data on the Electr-O-Line and Electr-O-Pulse electric control relays. The catalogue is available from Minneapolis-Honeywell Regulator Company, Brown Instruments Division, Station 64, Philadelphia 44, Pa.

Microwave Radio for Pipe Lines. Application of the new 2,000-megacycle microwave radio equipment to the pipeline industry is described in a new booklet available from the Westinghouse Electric Corporation. Features of the type *FR* microwave radio and type *FJ* multiplexing equipment and their importance to the pipe-line industry are discussed. Points covered include frequency division multiplexing, crystal frequency control, stand-by equipment, maintenance features, and many others. For a copy of this booklet,

(*Continued on page 66A*)

CON EDISON CHOOSES NOARK® BUS DUCT!



CONSOLIDATED EDISON'S new Astoria electric generating plant, across the East River from Manhattan, is nearing completion. Furnished throughout with the most modern and efficient equipment, Federal Noark feeder type Bus Duct of 2000 and 3000 amp. capacity has been installed to carry power to the motors driving the forced draft fans and boiler feed pumps. Designed to meet Consolidated Edison's low temperature specifications, the bus bars are specially wrapped and the bus duct housings are of aluminum. Installation was made by Lord Electric Company, Inc., New York City.

Federal Noark's standard line of bus duct has no equal for speed of installation, low-cost maintenance, and operational ease, speed and economy. In addition, Federal Noark, with its unusually wide experience, is outstandingly qualified to design and build special bus duct for the exact requirements of particular applications.

To assure top results on every usual and unusual demand for a bus duct electrical distribution system, write for the full Federal Noark Bus Duct story.

Federal Electric Products Company, 50 Paris Street, Newark 5, N. J.

Plants at Newark, N. J.; Long Island City, N. Y.; Hartford, Conn.; Cleveland, Ohio; St. Louis, Mo.; Dallas, Texas; Los Angeles, Calif. Affiliated plant, Toronto, Canada.

Federal Noark products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

FEDERAL NOARK®

"My brushes are giving me trouble, doc—how about giving me the Stackpole treatment?"

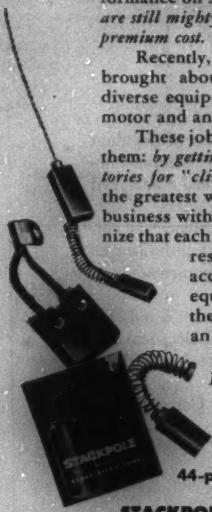
Small Motor Brush Clinic

...for longer life, greater efficiency

No doubt, you're getting pretty good brush life and performance on small motor applications these days. *But, chances are still mighty good that they can be materially improved—at no premium cost.*

Recently, for instance, Stackpole brush developments brought about worthwhile improvement on such widely diverse equipment as toy trains, a coal drill, a d-c gas pump motor and an ac-dc inverter.

These jobs were handled the way Stackpole likes to handle them: *by getting the actual motorized equipment into our laboratories for "clinical" test.* Here, Stackpole engineers combine the greatest wealth of small motor brush "know how" in the business with carefully planned experimentation. They recognize that each brush application differs from others in essential respects. These peculiarities are taken into full account in developing grades exactly suited for the equipment in question. And, more often than not, they come up with a brush recommendation that is an improvement over what has been used in the past.



NOTE: Stackpole brushes are sold only to manufacturers of original equipment.

Write on company stationery for the 44-page Stackpole BRUSH USERS' GUIDE.

STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

STACKPOLE

Master Test Code for TEMPERATURE MEASUREMENT of Electric Apparatus

Upon suggestion by the Standards Committee of the AIEE, the Instruments and Measurements Committee voted in 1941 the appointment of a subcommittee for preparing a Master Test Code for Temperature Measurement. The objective of this action was to amplify, and ultimately replace by a single code, those recommendations on temperature measurement which are applicable to commercial tests on a variety of electric machines and which had been duplicated in separate standards pertaining to specific types of apparatus.

The recommendations in this completed and approved code (number 551, effective as of August 1950) apply to the determination of operating temperature and of temperature rise of all electric machines, instruments, and apparatus in common use, where temperatures do not exceed 500 degrees centigrade. Standards pertaining to permissible temperature rise and corrections are not included.

Price: $0.80 to non-members, $0.40 to members of the AIEE. Orders should be sent to:

Order Department
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West 39th Street
New York 18, N. Y.

8-53

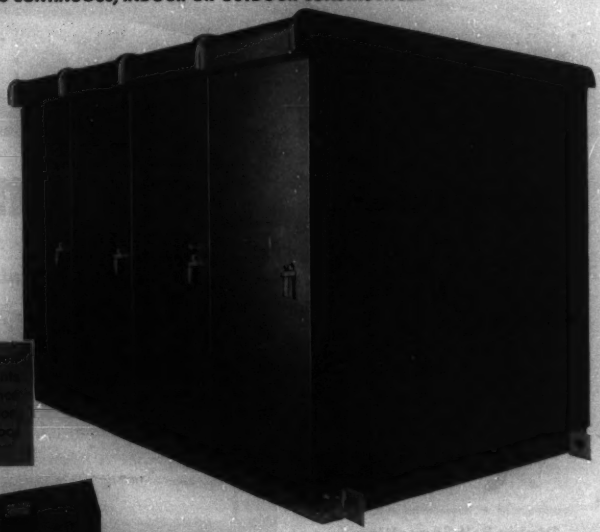
THE MODERN

STANDARDIZED, VERTICAL LIFT, METAL-CLAD, OIL CIRCUIT BREAKER SWITCHGEAR

2300, 4160, 4800, 7200 & 13,800 VOLTS, 50 TO 500 MVA INTERRUPTING CAPACITY, 600—1200 AMPERES CONTINUOUS, INDOOR OR OUTDOOR CONSTRUCTION.

STANDARD BASIC UNITS INCLUDE:

1) Swinging instrument panel; 2) Generator control; 3) Exciter control for generator; 4) Totalizing, metering and ground detection; 5) Incoming line; 6) Feeder; 7) Induction motor—full voltage starting; 8) Induction motor—reduced voltage starting; 9) Synchronous motor—full voltage starting; 10) Synchronous motor—reduced voltage starting; 11) Bus sectionalizing; 12) Auxiliary compartment and bus entrance; 13) Auxiliary compartment—miscellaneous equipment; 14) Air or oil isolator; 15) Bus entrance compartment.



Write for additional information

NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA

217 N. DETROIT AVE. TELEPHONE 3-5131

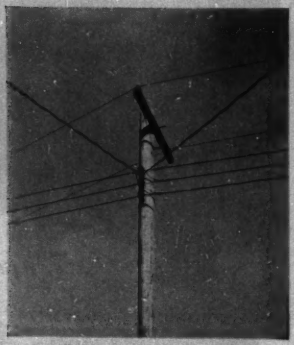
Rome Aluminum Triplex

Triplex Self-Supporting Secondary and Service Drop Cable—Regularly supplied with stranded or solid all-aluminum power conductors, insulated with RoPrene (Neoprene) and incorporating ACSR or other suitable bare neutral messenger. All-aluminum, copper or copperweld messengers are also available. RoLene (polyethylene) insulation can be supplied in place of RoPrene.

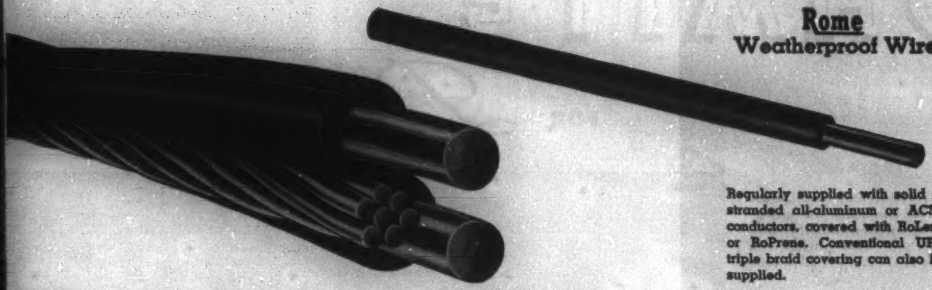
Rome Triplex Service Drop Cable provides neat, clean looking installation in new homes area.

Triplex is ideal for replacements on older houses too, particularly where eaves and roofs pose space problem.

Rome Triplex is less subject to damage by storm and falling tree limbs . . . will remain in operation SAFELY even when down.



Installation at pole and house is easy and quick, cutting costly manhours and permitting less expensive hardware.



Rome
Weatherproof Wire

Regularly supplied with solid or stranded all-aluminum or ACSR conductors, covered with RoLene or RoPrene. Conventional URC triple braid covering can also be supplied.

OFFERS YOU A HOST OF COST ADVANTAGES

Many applications of Rome Aluminum Triplex secondary and service drop cable show outstanding cost advantages over conventional bare or weatherproof open wire construction.

For one thing, by proper mechanical design it may eliminate one-third to one-half the number of poles normally required. This adds up to a substantial saving. Further, it is also possible to utilize mid-span connections for service drops.

Rome Aluminum Triplex is particularly desirable for new residential developments. It is neat in appearance while mechanical design and light weight minimize sag tendencies. This cable construction, with its strong messenger, also affords greater protection against wind and ice loading damage.

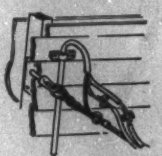
Fewer accessories are needed for secondary and service drop connections than for open wire construction. Maintenance is less costly; conductors are easily accessible.

Longer service life is assured because of mechanical design. RoPrene (Neoprene) and RoLene (polyethylene) insulation have exceptional resistance to weather and all climatic conditions. There are no braids to rot or festoon. Replacement is minimized.

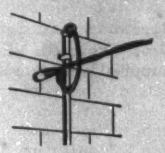
So whether it's secondary or service drop cable or weatherproof wire for distribution, Rome Aluminum offers you a host of advantages. May we send you samples?

Typical Connections

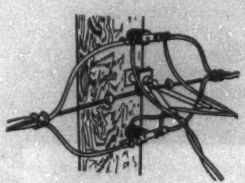
Service connection



Built-in attachment for dead-ending.



Dead end (house)



Service tap (from secondary cable)

It Costs Less to Buy the Best

Rome ALUMINUM

ROME CABLE CORPORATION, ROME, N.Y., AND TORRANCE, CALIF.

OHMITE®

FOR *Dependability*

RHEOSTATS

All-ceramic and metal, close control rheostats for unsurpassed dependability and smoothness of operation. Ten stock sizes, 25 to 1,000 watts.

TAP SWITCHES

Five compact models, 10 to 100 amperes, AC, up to 12 taps. All-ceramic and metal construction. Silver-to-silver contacts, with self-cleaning rotor.

RESISTORS

A wide range of dependable, fixed, adjustable, tapped, and non-inductive, power wire-wound resistors. Also a wide range of precision resistors.

R. F. CHOKES

Single layer R. F. plate chokes and power line chokes, on steatite or plastic cores. Protected by a special moisture-resistant coating.

Be Right with **OHMITE**

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WRITE on company letterhead for Catalog and Engineering Manual No. 40

BIDDLE
Instrument News

NEW HIGH VOLTAGE BRIDGE

Murray Loop Type for Use With Biddle Impulse Cable Fault Locating Transmitters

This new bridge is a high quality, compact, well-designed device to be used for localizing faults on power cables—particularly of the submarine and buried types. It is also useful in the case of duct line construction where water-filled manholes, ice, snow and traffic retard the location of faults by the impulse tracer method.

The entire bridge assembly is mounted in a metal case, 17" by 17" by 16" high. The galvanometer and counter are observed through a clear plastic window in the top of the metal case. An opening in the side of the case gives access to the input and output terminals. The entire assembly weighs about 60 pounds. Write for **BULLETIN 65-EE.**

ACCESSORY PICKUP LOOP

for use with Biddle Impulse Cable Fault Locator

In locating faults on buried cables there are cases where records of the exact location of the cable itself are questionable, and the problem becomes one of tracing the cable as well as locating the fault.

A pickup loop has been developed, as shown in the accompanying photograph, which is not only convenient to use in following buried installations, but is critical of any change in direction of the cable. It can also be used to estimate the depth of a cable by placing it on both sides of the cable run and noting the degree of tilt required to obtain a maximum signal. For complete description, write for **BULLETIN 65-EE.**

Although designed primarily for use on lead covered cable installed in ducts, Biddle Cable Fault Locators are also used on aerial and buried cable. The new Model 4 Transmitter has a maximum output of 15 kv d-c and a discharge capacitance of 2 muf.

The Model 4 Transmitter requires a source of supply of about 600 va at 115 volts a-c and weighs about 150 lbs. complete with all test leads. Unit can be carried in any ordinary passenger car. It may be used as a source of d-c voltage for proof testing of cable and other insulation, a very valuable feature both at installation and after alterations or repairs. It provides a d-c over-voltage test facility that is particularly suited to cables and other electrical apparatus in the lower voltage classes. It has a maximum proof testing current capacity of 15 milliamperes at about .7 megohms and about 50 milliamperes at short circuit.

The Model 4 Transmitter is a strongly built unit equipped with the highest quality components available, and designed for hard service. The structural parts are a combination of steel and aluminum with the exterior finished in grey enamel hammertone finish.

For complete information on Biddle Cable Fault Locator equipment, write for our new **BULLETIN 65-EE.**

B-935

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

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PHILADELPHIA 7, PA.

CANNON PLUGS for hermetic sealed applications

KH

RKH

HERMETIC SEALED Type RKH Plugs and KH Receptacles mate with their corresponding Cannon RK and K standard fittings. The basic construction of fused vitreous insulation around the contacts is same as GS type. Shell materials and finish are likewise similar. Various types of flange or hex-bulkhead styles may be made to order.

Refer to KH-1 Section in K Bulletin.

SUB-MINIATURE receptacles of the new Cannon "U" Series are used on miniature switches, relays, transformers, amplifiers, and other sealed components, requiring a true hermetic seal or a connector of sub-miniature size with performance superiority.

"U" plugs have a steel shell and "SILCAN*" insulator, cable relief and moisture resistant sleeve.

Bayonet-type locking means prevents vibration failure. Rated 1700v. d.c.; 5a. Available in 3, 6, and 12 contact arrangements with one plug style and two receptacles.

**Cannon Electric's special silicone resilient material.*

Refer to U-2 Bulletin

GS02

GS06

GS Types mate with standard AN(MIL) types. These highly successful hermetically sealed plugs (GS06) and receptacles (GS02) pioneered this field and are top quality fittings. Fused vitreous insulation provides a true hermetic seal for relays, position indicators, etc. Shells are steel, finished in cadmium plate and bleached Iridite; coupling nut on plug is natural finish Dural. Eyelet or solder pot terminals.

Built to resist thermal shock, −300°F. to +600°F., surpassing MIL Spec. GS02 Types will withstand operation temperatures 400°F. to 600°F., and pressures as high as 200 to 900 psi; specials to 7500 psi. GS Types approximate AN voltage and current ratings. Wide range of AN layouts available.

See GS-3 section in AN-8 Bulletin for details.

COMING: TYPE "DH" HERMETIC SEALED CONNECTORS SIMILAR TO PRESENT DA-15P

CANNON ELECTRIC

Since 1915

Factories in Los Angeles, Toronto, New Haven, Benton Harbor. Representatives in principal cities. Address inquiries to Cannon Electric Co., Dept H-117 P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.

(*Continued from page 58A*)

B-5851, write Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa.

Tubular and Flat Power Wire-Wound Resistors. Comprehensive data on adjustable features, brackets, characteristics, coating, dimensions, derating insulation, specifications, tolerances, and windings of tubular and flat power wire-wound resistors are given in this 12-page bulletin. Bulletin *C-7* is available from International Resistance Company, 401 North Broad Street, Philadelphia, Pa.

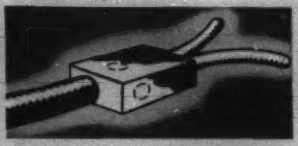
Capacitors and Pulse-Forming Networks. A brochure devoted to capacitors and pulse-forming networks has been published by Aircraft-Marine Products, Inc., Harrisburg, Pa. This 28-page book provides design and test data and gives information on all important features of these components. Particular attention is given to a new synthetic dielectric whose unique characteristics make it possible to effect tremendous reductions in size and weight in capacitors and pulse-forming networks. The book is illustrated with reproductions of actual test charts. Requests for copies should be addressed to Aircraft-Marine Products, Inc., 2100 Paxton Street, Harrisburg, Pa.

Electrodes. Air Reduction Sales Company has announced the availability of a 50-page pocket guide to Airco electrodes. Over 30 different electrodes—stainless, mild, and high-tensile steels, cast iron, nonferrous, low-hydrogen, and hardfacing—are described as to chemical analysis, procedure for welding, and application. Other sections in the booklet include mechanical properties, testing of electrodes, and specifications. A copy of this illustrated guide can be obtained by writing Air Reduction Sales Company, 60 East 42d Street, New York 17, N. Y.

Manual on Demand Meters. A 48-page manual on demand metering has been announced as available from the General Electric Company, Schenectady 5, N. Y. The illustrated publication, *GET-2327*, describes in detail the theory, economics, operation, and application of demand meters. It provides an excellent summary of the principles and problems of demand metering; a reference for helping in specific demand-measuring application; and a textbook for students and trainees. Rather than emphasize the details of meter construction, installation, or maintenance, the manual serves as a centralized source of basic information.

Guide to Parts and Picture Tubes. A 32-page guide of original television parts and picture tubes for replacement in Du Mont television receivers has been published by the replacement sales department, Allen B. Du Mont Laboratories, Inc., and is now available to servicemen. The guide, cross-indexed three ways for easy reference, also includes electrical values of the components. The replacement catalogue can be obtained by servicemen from their Du Mont parts jobbers.

How to get longer life out of your portable cords and cables!

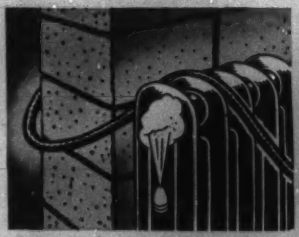


1 USE junction or distribution boxes for making multiple power connections in working places.

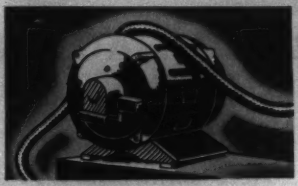
2 PROTECT cables with fuses or circuit breakers of the proper rating for the service. Make sure that circuit breakers will operate properly.

3 PROTECT cables from being run over by heavy equipment. Running over the cable a few times may not cause immediate failure, but may do internal damage which will shorten its life. If the cable must be run across an aisle, place boards on either side as one would for a hose. If it is in use for only a short time, it should be thrown over the truck.

4 USE flame-resistant cables wherever possible.



5 DO NOT have portable cords and cables running over steam pipes or other heat-transmitting equipment.



6 KEEP cables away from sparking motors and high voltage equipment. The ozone generated by sparking commutators attacks rubber jackets, causing cracking.

7 AVOID overloading of cables. Where possible, use I.P.C.E.A. recommended current ratings.

8 AVOID dragging portable cords around rough edges or sharp corners Bruises and cuts hasten deterioration of the jacket. Never yank cords to remove kinks or loosen them when caught on a projection.

9 AVOID running portable cables on pulleys or drums too small for the size of the cable; observe recommended I.P.C.E.A. minimum diameters.

10 KEEP cords away from oils and greases. If they do get into oil, they should be wiped off as soon as possible. Avoid having cords lie in pools of water, chemicals or grease.

11 BUY cables that can carry the required current without overloading or overheating. They should be flexible (have sufficiently fine strands) for the intended use.

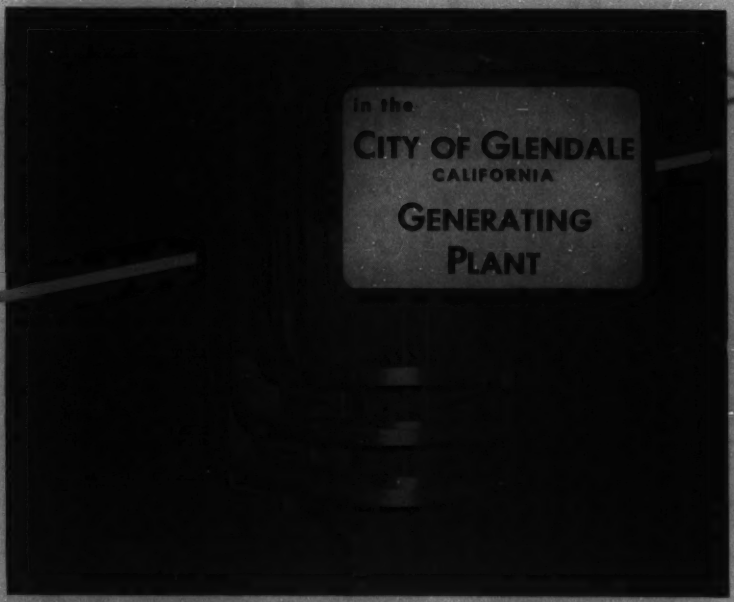
FOR FREE REPRINTS OF THIS PAGE, WRITE TO ADDRESS BELOW.

UNITED STATES RUBBER COMPANY

U.S. RUBBER
SERVING THROUGH SCIENCE

Electrical Wire and Cable Department

ROCKEFELLER CENTER • NEW YORK 20, NEW YORK



Cope CABLE TROUGH AGAIN PROVES ITS

... Simplicity of Installation
... All-around Economy
... Accessibility to Cable

The versatility and simplified design of the Cope system of Cable Trough and Fittings make it readily applicable to any layout. This is clearly seen in the above photograph showing part of a recent installation at the Glendale Generating Plant. Notice how the Cope Trough is supported by simple wall brackets. Observe, too, that both vertical and horizontal runs are made with standard trough and fittings — turns, branches and reductions.

The High Voltage sign on the top tray emphasizes another Cope Trough feature. Here 480 volt Neoprene jacketed power cables are carried in the same tray with control cables. A barrier strip provides adequate separation while permitting easy access to the lines. The lower tray will carry 2400 volt Neoprene jacketed power cables and ultimately will be equipped with a solid Cope Trough cover. Future expanding needs will be met by adding a fourth tray above the other three.

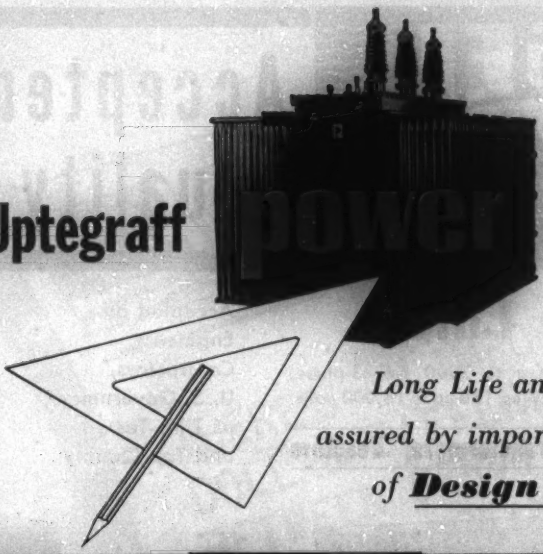
Learn how you, too, can cut cable installation costs and labor . . . write for bulletin on Cope Cable Trough.

T.J. Cope INC.

You know Cope by these products

711 SOUTH 50th ST., PHILADELPHIA 43, PA.

Uptegraff Power Transformers



Long Life and Low Maintenance assured by important features of ***Design and Construction***

RUGGED

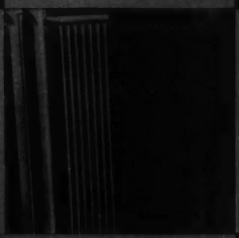
Special tank bracing withstands pressures of ±10 psi for ratings of 44 KV and less, and ±15 psi for higher ratings. Radiators are sturdy, yet accessible for cleaning and painting.

TIGHT

To eliminate leaks in sealed joints, a modern super-sensitive electronic leak detector is used. It will find leaks as small as one ounce of air per year!

UNDERCOATED

The under surfaces of all Uptegraff Power Transformers are treated with a heavy coating that protects inaccessible areas against corrosion.



SHOT BLASTED

Tanks are thoroughly cleaned by shot blasting to prepare surface before protective paint coats are applied.

TESTED

Every Uptegraff Power Transformer is thoroughly tested before shipment. Modern test equipment includes a 1.5-million volt surge generator. We are fully qualified and equipped to make all NEMA, AIEE, ASA and other tests up to 10,000 KVA.

ALL SIZES

Made in sizes to 10,000 KVA, 115 KV for indoor or outdoor service. Oil or askarel filled. Uptegraff transformers meet the standards of ASA, NEMA and AIEE, and are *fully guaranteed.*

R. E. Uptegraff Manufacturing Co.

Scottdale, Pa.

SORGEL AIR-COOLED Dry-Type TRANSFORMERS

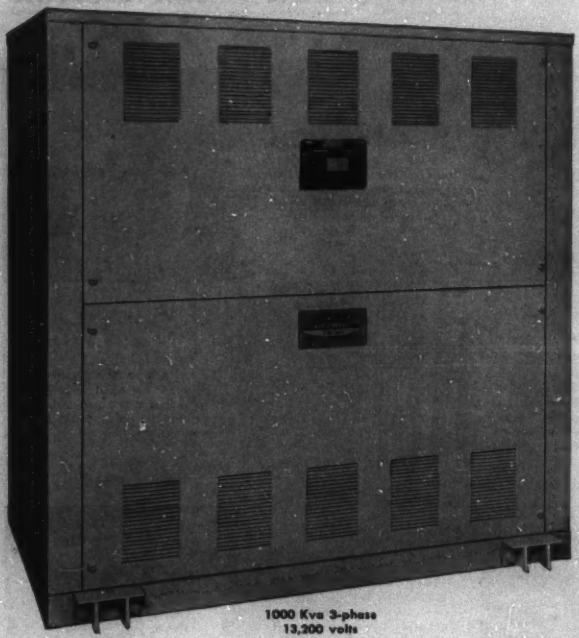
Accepted Quality

Complete Line

¼ to 1500 Kva single phase. 1 Kva to 3000 Kva 3-phase, 2-phase, and phase changing. All voltages, 120 up to 15,000 volts.

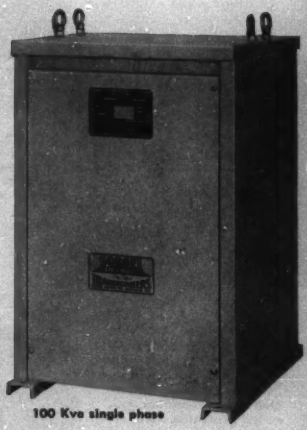
Also Substations, Special Transformers, Reactors

Accepted by Engineers, Contractors, U. S. Government, as Time-Tested and Top Quality



1000 Kva 3-phase 13,200 volts

¼ Kva single phase 480/240 to 240/120 volts

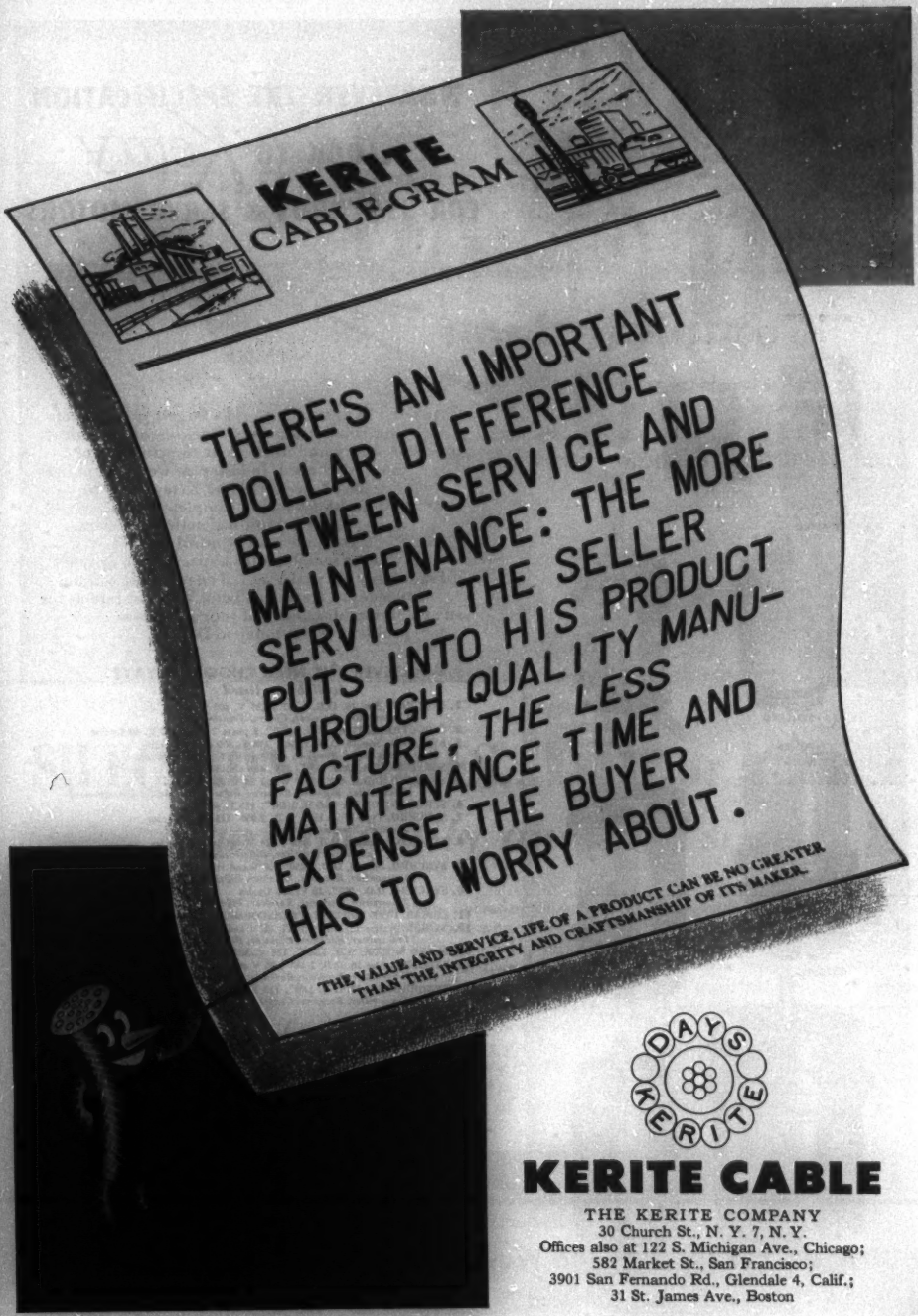


100 Kva single phase

Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 846 West National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled Dry-type Transformers — Over 35 years


KERITE
CABLE-GRAM
THERE'S AN IMPORTANT DOLLAR DIFFERENCE BETWEEN SERVICE AND MAINTENANCE: THE MORE SERVICE THE SELLER PUTS INTO HIS PRODUCT THROUGH QUALITY MANUFACTURE, THE LESS MAINTENANCE TIME AND EXPENSE THE BUYER HAS TO WORRY ABOUT.
THE VALUE AND SERVICE LIFE OF A PRODUCT CAN BE NO GREATER THAN THE INTEGRITY AND CRAFTSMANSHIP OF ITS MAKER.
DAY
KERITE

KERITE CABLE

THE KERITE COMPANY
30 Church St., N. Y. 7, N. Y.
Offices also at 122 S. Michigan Ave., Chicago;
582 Market St., San Francisco;
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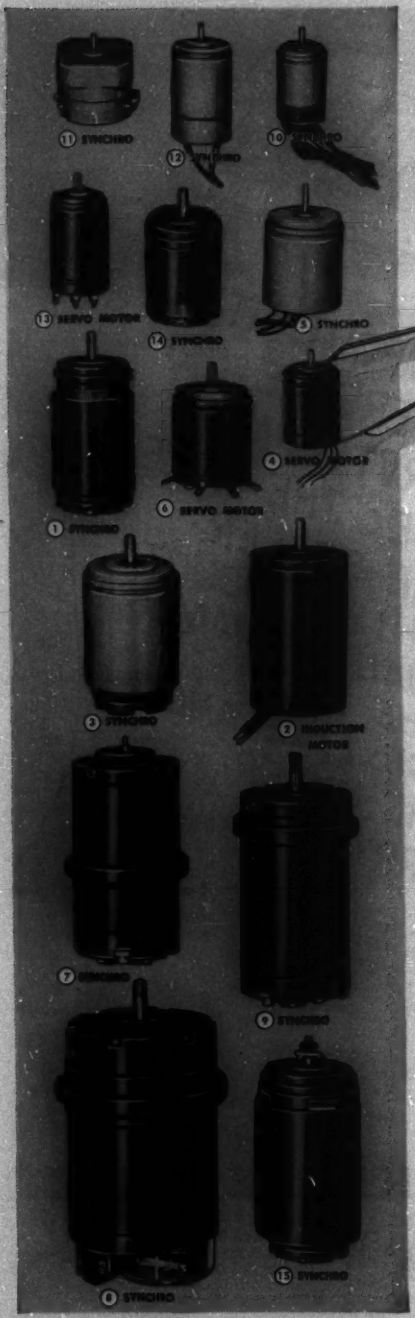
31 St. James Ave., Boston



WHATEVER THE SPECIFICATION ...LOOK TO *Ketay* FOR SYNCHROS & SERVO MOTORS

KETAY, the world's largest producer of government approved synchros, offers high precision rotary and instrument components for most every need. Industry, as well as suppliers to the Armed Forces, will find Ketay ready to solve their problems with a complete line of synchros, servos, magnetic amplifiers, computers and control systems.

If you are searching for a specific size or type... if availability is a problem... if engineering counsel is needed... Ketay can help. Why not join us for an exploratory discussion of your particular problem. Write today to Dept. E

WHATEVER THE NEED CHOOSE KETAY!

Available as listed

1. SYNCHRO, Size 16, O.D. 1.537", 115 V, 400 Cycles
   (Transmitter, Receiver, Control Transformer)
2. INDUCTION MOTOR, O.D. 1.750", 3 phase 2 Pole, 115 V, 60 Cycles
3. SYNCHRO, Size 18, O.D. 1.750", 115 V, 400 and 60 Cycles
   (Transmitter, Receiver, Differential, Control Transformer)
4. SERVO MOTOR, O.D. .937", 26V, 400 Cycles
5. SYNCHRO, O.D. 1.437", 14.4 V and 26 V, 400 Cycles
   (Transmitter, Receiver, Resolver, Differential, Control Transformer)
6. SERVO MOTOR Mk 7, O.D. 1.437", 115 V, 400 Cycles
7. SYNCHRO, Type 1F or 1HG, O.D. 2.250" 115 V, 60 Cycles
   (Receiver, Transmitter)
8. SYNCHRO, Size 31, O.D. 3.10", 115 V 400 and 60 Cycles
   (Transmitter, Receiver, Differential, Control Transformer)
9. SYNCHRO, Size 23, O.D. 2.250", 26 V and 115 V 400 & 60 Cycles
   (Transmitter, Receiver, Resolver, Differential, Control Transformer)
10. SYNCHRO, O.D. .937", 26 V, 400 Cycles
    (Transmitter, Receiver, Resolver, Differential, Control Transformer)
11. LINEAR TYPE CONTROL TRANSFORMER, O.D. 1.625", 26 V, 400 Cycles
12. SYNCHRO, Size 11, O.D. 1.062", 26 V and 115 V, 400 Cycles
    (Transmitter, Receiver, Resolver, Differential, Control Transformer)
13. SERVO MOTOR, O.D. 1.062", 115 V, 400 Cycles
14. SYNCHRO, Size 15, O.D. 1.437", 26 V and 115 V, 400 Cycles
    (Transmitter, Receiver, Resolver, Differential, Control Transformer)
15. SYNCHRO, Size 19, O.D. 1.90", 115 V, 400 Cycles
    (Transmitter, Receiver, Control Transmitter)

Ketay MANUFACTURING CORP.

555 Broadway, New York 12, N. Y.

PACIFIC DIVISION
12833 Simms Ave., Hawthorne, California

DESIGN
DEVELOPMENT
MANUFACTURE ...of precision instruments, components, and systems.

- KINETIX INSTRUMENT DIVISION
- RESEARCH & DEVELOPMENT DIVISION

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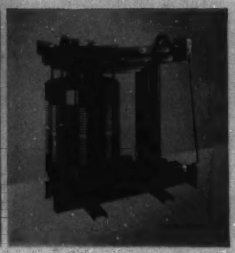

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* Sealed Dry Type Transformers Proved Safe by Test, Tipton, AIEE Summer General Meeting, June 15, 1953. AIEE Technical Paper 53-45.

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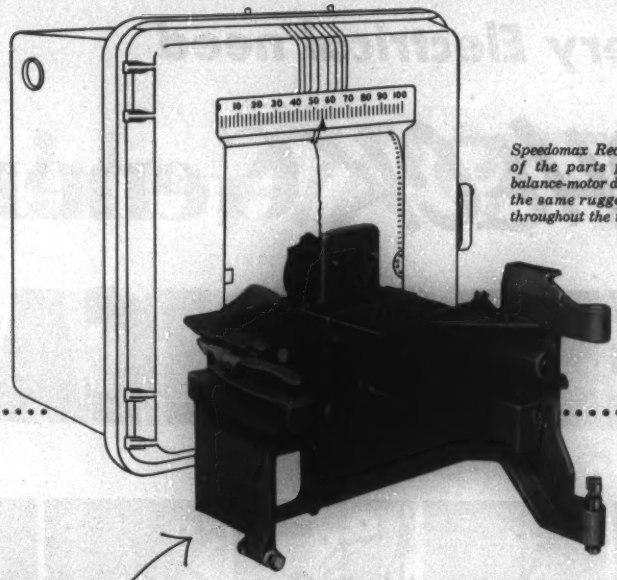

Speedomax Recorder and a few of the parts for its circuit-balance-motor drive. You'll find the same rugged construction throughout the instrument.

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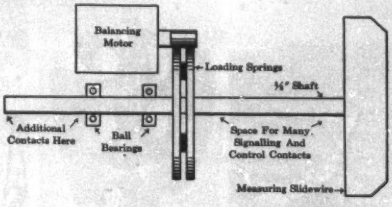

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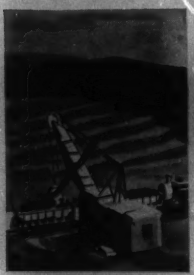

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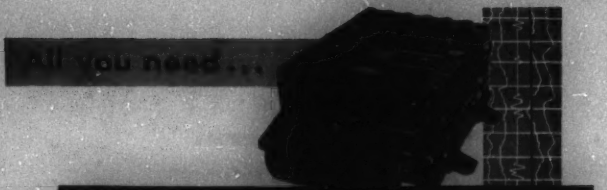

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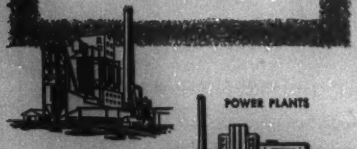

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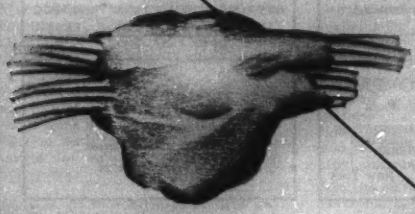

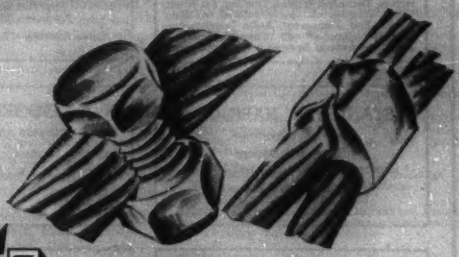

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out all air and moisture to guarantee lasting protection against corrosion. You can prevent trouble even in bi-metallic taps by eliminating the electrolyte. *Kearney Airseal*, a pliable, removable high-dielectric compound is quickly and easily kneaded around the connection; permanently seals out corrosion. *Airseal* is supplied in 5 convenient sizes of pads and rolls.

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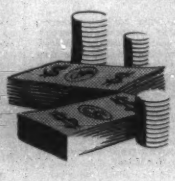

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INSTRUCTORS, young, for electrical engineering. (a) One with special interests in electrical machinery. (b) One with special interests in electronics and communication. Opportunity to carry on the graduate work leading to Master's degree in electrical engineering. Positions start September 12, 1953. Location, Midwest. Y-8748.

ELECTRONICS ENGINEER, young, with college degree, preferably in electrical engineering with major or minor in electronics. Should have 2 or more years' experience in construction and design of electronic circuits, with some experience in industrial applications, including communications. Salary, up to $6000 a year. Location, Tennessee. Y-8756.

INSTRUCTOR in electrical engineering, to teach basic electrical engineering to mechanical and chemical engineers. Also some circuit courses to junior electrical students. Interests should be in the power field. Should have Master's degree and have 2 years' teaching experience. Salary, $3800–$4700 a year. Position starts September, 1953. Location, East. Y-8770.

ELECTRICAL ENGINEER for the development, design and manufacturing of small indicating, electrical instruments. Opportunity to take charge of engineering. Should be college graduate, with 3 to 5 years' experience. Excellent opportunity with a small nationally-known company. Salary, $5000 a year and up. Location, Pennsylvania. Y-8777.

RATE ENGINEERS, 35–55, electrical graduates, with thorough knowledge of all factors connected with electric rates. A former utility employee specialized in rates and in dealing with regulatory commissions, or an engineer who has served as a utilities consultant in various capacities would fit the requirements of the position. Company analyzes rates charged for electricity, gas, water and steam anywhere in the U. S. for the purpose of securing lower rates for their clients. Location, New York, N. Y. Y-8799.

GENERAL SUPERINTENDENT with at least 5 years' electrical repair and contracting experience in marine fields, to redesign motors and controls, supervise shop and ship repairs, subcontracting, job surveys and make customer contacts. Salary, $8000 a year plus bonus. Location, New York, N. Y. Y-8804.

ENGINEERS. (a) Electronics Engineer—Servos and Controls, to develop control equipment products. Must be experienced and have good education in electronics. Knowledge of servomechanisms helpful. Technical supervisory responsibilities. Excellent working conditions and opportunities to demonstrate ability. Salary open. (b) Designer-Electronic Controls, for aircraft product development work. Must be experienced and familiar with government design specifications. Excellent working conditions. Salary open. Location, Connecticut. Y-8844.

FIELD SERVICE ENGINEERS with good overall knowledge in electronics, and some direct experience in radar equipment. Will represent company in a field capacity supervising the installation, maintenance, and operation of various types of electronics and communications equipment. Should possess some education in the field of electronic theory, and be well versed in basic radio theory. Assignments throughout the world; each assignment will average 14 months duration. Salary, $4150 a year and up depending on experience, plus 25% overseas allowance. Living allowance of $6 to $12 a day depending on location if other han home office. Headquarters, Maryland. Y-8849.

We desire personnel of the highest caliber—experienced in the field of airborne automatic electro-mechanical control equipment.

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SENIOR ELECTRICAL ENGINEERS, 25–45, B.E.E. degree, experienced in the design of transformers (audio, power and pulse), reactors and filter networks. Salary, $10,000–$20,000 a year. Travel expenses paid for pre-employment interview. Moving expenses paid. Location, upstate New York. Y-8851.

ELECTRONIC FIELD ENGINEERS with experience in maintenance and trouble shooting on airborne radar systems. Prefer experience on equipment in the 1,000 megacycle range. Knowledge of distance measuring equipment. Very-high frequency. Experience and interest in teaching and instructing the operations of instrument landing systems, in addition to field engineering work on ILS. Experience and interest in field engineering work on electronic counter measures. Army Directional Range on Radar systems. Salary, up to $6500 a year plus $9.00 per diem allowance for living expenses while in the field. Considerable traveling. Location, New Jersey. Y-8853.

JUNIOR ELECTRICAL ENGINEERS, preferably with B.S. degree. No experience required of recent graduate in upper half of class; some experience in electrical control work desirable. Company specializes in electrical regulating and control systems and servo mechanisms, particularly those employing magnetic amplifiers, electromechanical regulators and transistors as components. Will be trained for senior electrical engineering positions. Salaries, $4500–$5500 a year. Location, New Jersey. Y-8859.

INSTRUCTOR, preferably with electrical engineering background, to teach mechanical drawing, descriptive geometry, mechanics and strength of materials. Salary, $3000–$4000 for 9 months. Location, Connecticut. Y-8862.

DIVISION MANAGER, electrical engineer, 35–40, with at least 5 years' experience in development of controls or switches for low-voltage appliance field. Knowledge of switches and bi-metal work for controls. Will manage department in research and development of electro-mechanical switches and devices. Salary, $10,000 a year. Employer will pay placement fee. Location, Chicago, Illinois. C-1003.

APPLICATION ENGINEER, electrical engineer 25–30, with at least 2 years' experience in utilities or heavy industrial users of power. Knowledge of high-voltage equipment. Duties will include application work in sales department of manufacturer of high-voltage equipment. Can lead into sales eventually if desired. Employer will pay placement fee. Salary, to $6500 a year. Location, Chicago, Illinois. C-1008.

LUBRICANT SALES ENGINEER, mechanical, electrical or industrial; age to 35; at least 2 years' experience in industrial sales and preferably with lubricants, or maintenance products of similar nature. Knowledge of industrial lubricants helpful. Will sell line of petroleum products to industrials. Position is with major oil company. Salary, to $6000 a year. Car furnished. Location, Chicago, Illinois. C-1023.

DEVELOPMENT ENGINEER; at least 1 year's experience in radio relays. Knowledge of telephone or radio relays. Duties will include development of radio relays and some model making. Company manufactures relays. Salary, $6000 a year. Employer will pay placement fee. Location, Chicago, Illinois. C-1059.

ELECTRICAL ENGINEERS — SENIORS — Experienced public utility electrical design and distribution engineers required by an established consulting organization for work on continued program of plant expansion, distribution planning and betterment work for foreign public utility operating subsidiary companies. Location New York, possibly some foreign travel. Preferred age range—30–45. Attractive salaries. Excellent opportunities for qualified men. Write giving fullest details of qualifications and experience. Address Box 416.

ELECTRICAL ENGINEERS—JUNIORS—Graduate electrical engineers for design and distribution work required by an established consulting organization for work on continued program of plant expansion, distribution planning and betterment work for foreign public utility operating subsidiary companies. Location New York, some foreign travel. Preferred age under 30. Experience 0–5 years. Salary commensurate with qualifications. Splendid opportunities for right men. Write giving age and fullest details of qualifications and experience. Address Box 417.

ASSISTANT CHIEF ENGINEER—Ohio company manufacturing electronic equipment has opening for electronic engineer approximately 27–31 years of age in capacity of administrative assistant to the Chief Engineer. Duties will include engineering office work, supervision of laboratory projects and occasional traveling. Must have at least 5 years professional experience in circuit design and project supervision. Starting salary $7000 per year. Allowance for moving expense. Replies held in confidence. Submit resume to Box 427.

RIGHT OF WAY AGENTS to acquire electric transmission line rights of way in eastern seashore area. Excellent opportunity with minimum employment of 18 months. Write full details, experience and salary expected. Box 433.

JUNIOR ENGINEER—Electrical Engineering background with 3 to 4 years' experience in the power industry or manufacture of power industry equipment. Very fine opportunity with a well established growing company. Location Western New York. Box 434.

ENGINEERING COLLEGE IN NEW YORK CITY HAS opening for instructor to teach electrical engineering fundamentals, September, 1953. Interest in electric machinery desirable, not essential. Can coordinate teaching schedule with part-time graduate study schedule in New York area. Salary, to $4,000 per year. Box 435.

ELECTRIC SYSTEM PLANNING ENGINEER—Medium sized midwest electric utility serving metropolitan area with good growth prospects has opening for electrical engineering graduate. Experience in electrical transmission and distribution engineering desirable. Work requires ability to make economic and operating evaluations of alternate schemes for electrical transmission and distribution. Experience and ability in preparing clear and concise reports essential. Salary commensurate with experience and/or ability. Box 436.

ELECTRIC SUBSTATION DESIGN ENGINEER—Medium sized midwest electric utility serving metropolitan area with good growth prospects has opening for graduate electrical engineer. Duties consist of the layout, design, selection of equipment, preparation of work orders, and co-ordinating all details of equipment procurement and construction related to electrical substations. Some experience as project engineer on this type work is desirable but not altogether necessary. Will consider training young graduate engineer. Salary commensurate with experience and/or ability. Box 437.

INSTRUCTOR, ELECTRICAL ENGINEERING to teach Service courses and Industrial Electronics, beginning September, 1953. Salary and rank open. Apply Electrical Engineering Department, University of North Dakota.

IOWA STATE COLLEGE has three instructorship vacancies in Electrical Engineering. Address Head, E.E. Department, Ames, Iowa.

ELECTRICAL ENGINEER—Must be a graduate Electrical Engineer under 32 years of age with 3 to 5 years supervisory experience in industrial plant electrical maintenance. Location Central Illinois. New multi-million dollar plant. Salary open. Write giving complete details of education, experience, and salary expected to Personnel Manager, National Petro-Chemicals Corporation, Box 109, Tuscola, Illinois.

SALES ENGINEERS—INDUSTRIAL NUCLEONICS is a young growing company in the field of application of atomic energy to industrial uses. We have already become the acknowledged leader in the private development and manufacture of nuclear industrial equipment for heavy industry. If you are a graduate engineer with successful experience selling capital goods or measurement and control equipment, you will find unique opportunities in our field. Locations available are Pittsburgh, Chicago, Southern Ohio and Southern United States. Salary and commission. Send complete resume to Industrial Nucleonics Corporation, 1205 Chesapeake Avenue, Columbus 12, Ohio

ELECTRICAL ENGINEER, BSEE 1938, EE 1944, Missouri School of Mines, 37, single, registered, member AIEE, Fellow AAAS, 14 years' executive management of power utilities and construction supervisor-inspector of steam-electrical central stations. Prefer latter with present minimum salary $10,000 for work in U.S.A. Available world wide. Box 431.

ELECTRICAL ENGINEER, 38 MSEE from MIT. 11 years' experience in automatic feedback controls in fields of underwater ordnance, atomic energy applications, guided missiles, and automatic weighing devices. Present salary $9,500. Desire challenging position in research or development. Prefer to locate in east. Write Box 438.

ELECTRICAL ENGINEER, age 31 years, married. Experience: electrical superintendent of large mining/milling project; distribution superintendent in city of 300,000; construction of lines and substations; electrical shop operation. Desires similar work of equal responsibility. Reply Box 439.

ENGINEER, BSEE, Regis Professional, 44; 20 years varied electrical, mechanical and marine experience in power application, operation and maintenance; good background in project study, planning, specifications and supervision of engineering personnel and activities in office and field; desire opportunity in plant or maintenance engineering or development. Box 440.

WANTED: Back copies of the March 1953 issue of ELECTRICAL ENGINEERING.

Please mail (via parcel post) to American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y., printing your name and address upon the mailing wrapper. Twenty-five cents, plus postage, will be paid for each copy returned.

ELECTRICAL ENGINEER, age 24, single, M.S.E.E. (M.I.T.), excellent background in computers and control systems, 2½ years' experience in digital computer applications, some teaching, some business background. Want challenging opportunity with future, in field of control and/or system design. Would consider foreign travel. Write Box 441.

ELECTRICAL ENGINEER, BSEE, 27, married, 3 years' experience automatic fire control systems, magnetic amplifiers, servomechanisms, complex relay networks. Desires design work on automatic factory equipment, servo control devices, closed loop systems any field. Write Box 442.

ELECTRICAL ENGINEER, 35, registered, married, 14 years solid experience in power generation, distribution and transmission, substations, switchgear, control, etc., both in field and office, including 5 years in South America (oil refinery, etc.). Now in top supervisory position. Will head project. Available about October, 1953. Write Box 443.

ENGINEER—BSEE(Power)-AIEE-ASME, 30, single. Ten years varied experience in design and field engineering. Underground and overhead distribution—system planning circuit analysis—motor control—equipment installation—some plant maintenance. Knowledge of Spanish, Portuguese, Italian. Two foreign contracts completed. Desire design or field work—foreign. Write Box 444.

PRIMARILY electrical, native USA, licensed, 30 years' experience, including 7 overseas, in generating station engineering, design, and allied fields. Now engaged overseeing engineering firms in power development program. Box 445.

ELECTRICAL ENGINEER—Age 37, BSEE, family, sober, now head electrical engineering steam plant construction, previously on 3 hydro stations installed total 14 generator-turbines minimum 28,000 kva plus auxiliary equipment. 13 years' experience in power, substations, controls, carrier, imped relays, equipment, switchgear. Can design, install, check, operate. Have supervised major phases of construction including mechanical civil, structural. BECAUSE OF WIFE'S HEALTH MUST MOVE SOON from present location to DRY climate. West or Southwest U. S., namely from W. Texas, N. to Colorado, West to S. California. Desert type area most suitable. Prefer job not to be dreary, but can handle consulting, manufacturer's representative, construction, pure desk job last choice. Starting salary not too important if future suitable. Member army reserve 14 years, Lt. Colonel, USAR-CE. Write W. G. Moeller Box 51, Sheffield, Alabama.

ELECTRICAL ENGINEER, 38, married, 11 years' experience, 5 years in electrical design and development of electronic equipment, 6 years in electrical design and development of electrical equipment. Desires position in electrical engineering. Prefer Cleveland area. Box 446.

ELECTRICAL ENGINEER, 30, married, 2 years' experience in electrical design and development of electronic equipment, 4 years in electrical design and development of electrical equipment. Desires position in electrical engineering. Prefer Cleveland area. Box 447.

ELECTRICAL ENGINEER, 30, married, 2 years' experience in electrical design and development of electronic equipment, 4 years in electrical design and development of electrical equipment. Desires position in electrical engineering. Prefer Cleveland area. Box 448.

ELECTRICAL ENGINEER, 30, married, 2 years' experience in electrical design and development of electronic equipment, 4 years in electrical design and development of electrical equipment. Desires position in electrical engineering. Prefer Cleveland area. Box 449.

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When answering an advertisement, send all replies to box number specified, c/o ELECTRICAL ENGINEERING, 500 Fifth Avenue, New York 36, N. Y., unless other address is given.

Positions Available

SOUTHEASTERN UNIVERSITY has opening for Associate Professor of Electrical Engineering in communications work. Ph.D. required. Compensation including research income, $9,300. Also several openings in research division for young graduates who may obtain M.S. degree while working. Write Box 379.

INSTRUCTOR OR ASSISTANT PROFESSOR OF ELECTRICAL ENGINEERING—M.S. desired with specialization in power; to teach machinery and circuits courses. Position available September 1953. Send application to Chairman, Department of Electrical Engineering, State College Station, Fargo, North Dakota.

Positions Wanted

ELECTRICAL ENGINEER, P.E.-N.Y., 31, 5 years Utility and Consulting Engineer. Experience with network and transient analyzer studies, relaying, carrier, etc. Desires position with public utility. Write Box 425.

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reply, giving full resume of qualifications, to Martin Goland, Associate Director for Engineering, Midwest Research Institute, 4049 Pennsylvania Ave., Kansas City, Mo.

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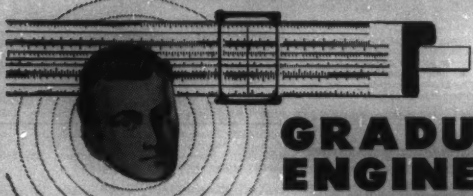

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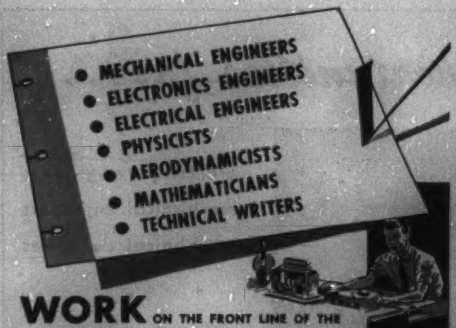

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BIBLIOGRAPHY on ELECTRONIC POWER CONVERTERS

A compilation of considerable reference data on power rectifiers and inverters, published in chronological sequence beginning with 1903. Items are arranged alphabetically by the author's surname, and are further classified according to text matter. Prepared by the Subcommittee on Papers and Speakers of the AIEE Electronic Power Converter Committee.

Priced at $1.00 ($0.50 to AIEE members), publications S-35 (February 1950) is available from the Order Department, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 33 West 39th Street, New York 18, N. Y.

8-53

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(Issued October 1952)

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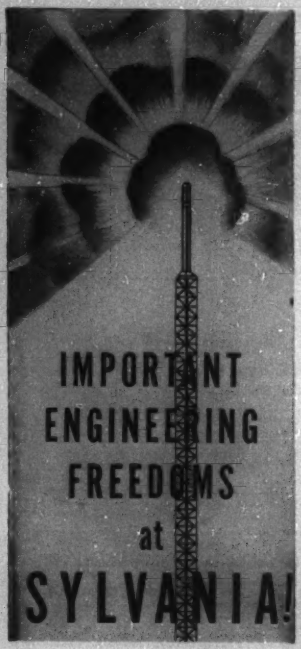

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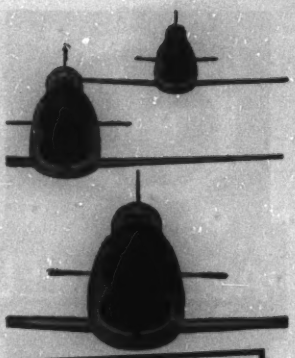
Assurance is required that the relocation of the applicant will not cause the disruption of an urgent military project.



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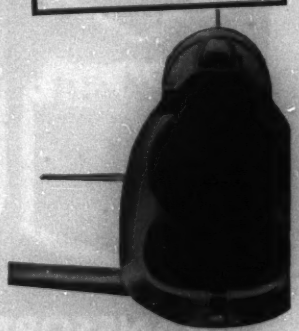

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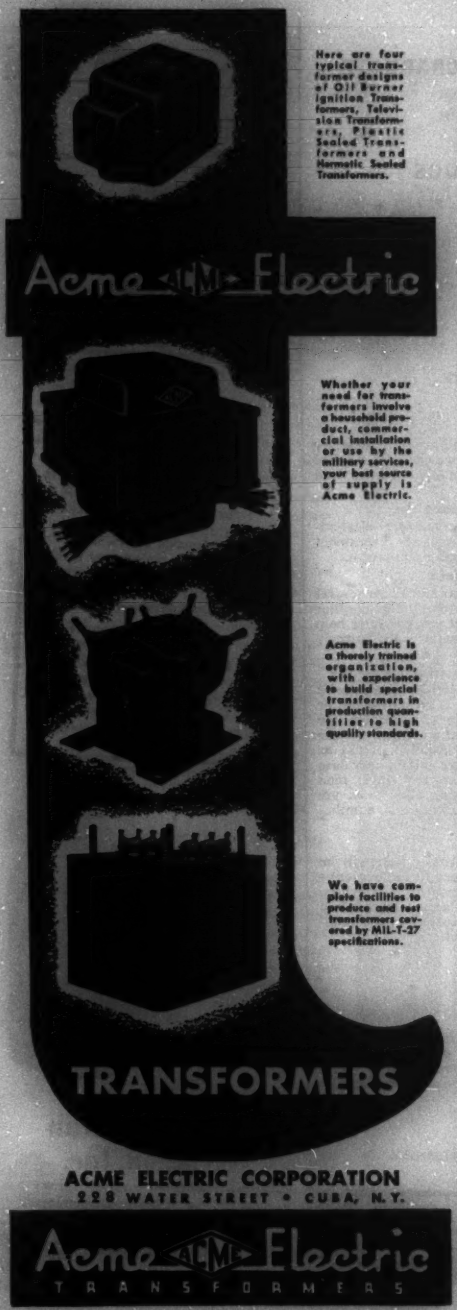
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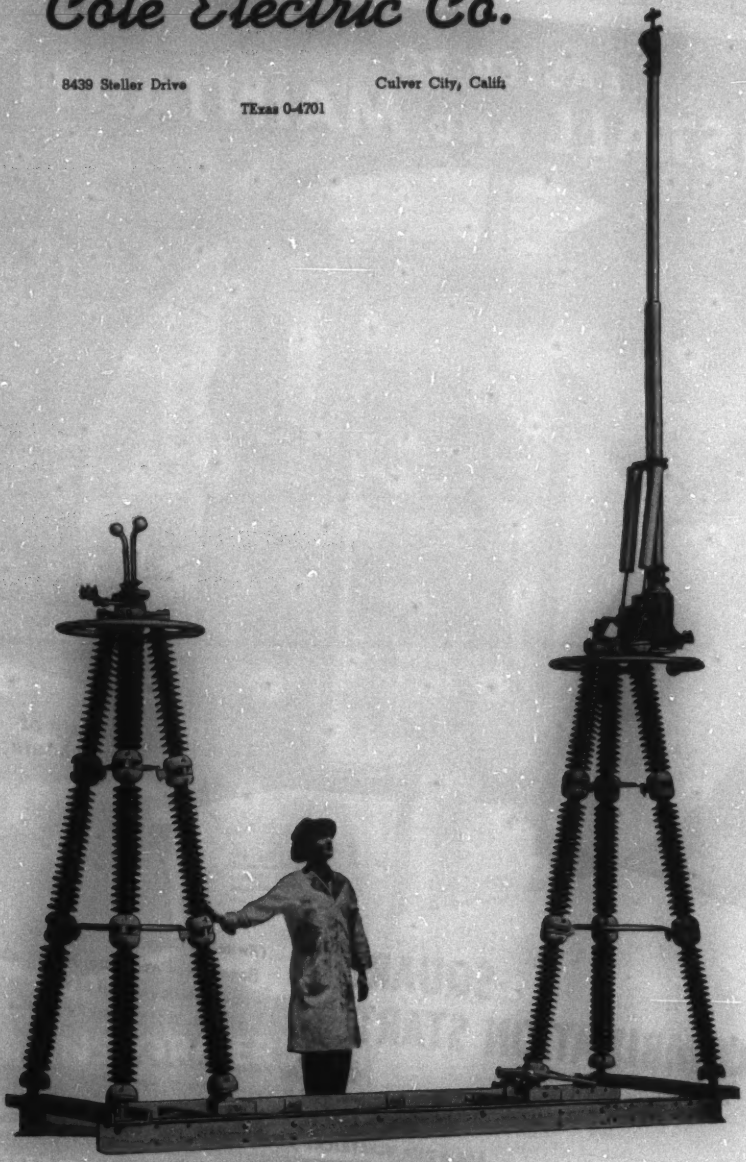

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